

# ADVANCE COPY

# SCIENCE

25 November 1955

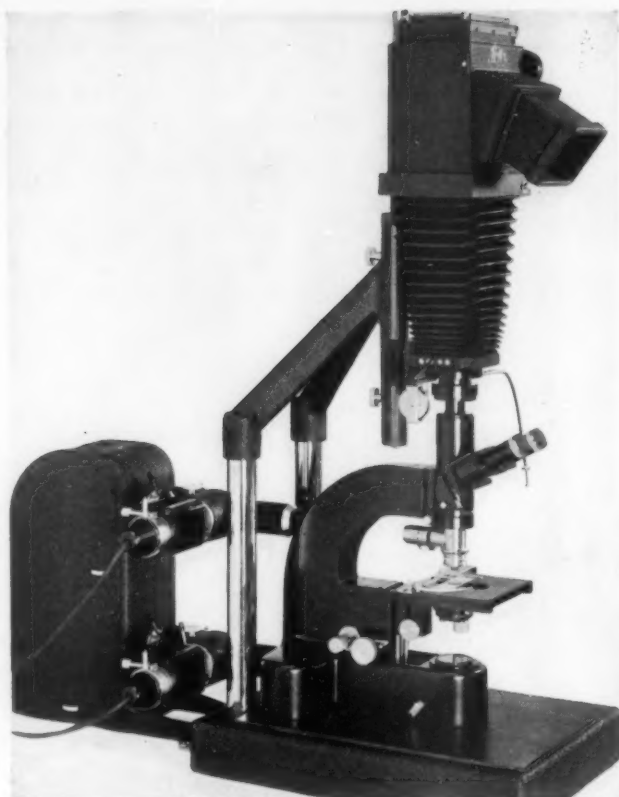
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The Antigen-Antibody Reaction	Allergy
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25 NOVEMBER 1955

995



## Ultra-Violet **BLACK** Light

### Questions and answers help clarify terminology

**Question:** What is Black Light?

**Answer:** It is a name applied to invisible ultra violet light, the band of energy between the visible and x-ray region of the spectrum.

**Questions:** What are the regions of visible light in Angstroms? In Microns?

**Answer:** An angstrom is equal to 1/250 millionth of an inch. A micron is equal to 10 angstrom units.

**Question:** How many types of ultra violet energy are there?

**Answer:** Broadly speaking, there are three—short wave, middle and long wave.

**Question:** What is short wave ultra violet?

**Answer:** It is that portion of the spectrum from 1850 angstroms to 2800 angstroms—also known as far ultra violet. It includes the 1850A band which produces ozone, and the 2537A band, known as the "germicidal band", which effectively destroys airborne bacteria, or surface bacteria of molds.

**Question:** What is middle ultra violet?

**Answer:** Middle ultra violet extends from 2800A to 3200A. It includes the peak "suntan" band of 2967A, the region producing the maximum source of Vitamin "D". Sun "tan" is due to this band of energy in sunlight, and produced by sun lamps. It does not produce useful fluorescence.

**Question:** What does the long wave include?

**Answer:** Long wave covers 3200A to 3900A, also known as near ultra-violet or Wood's light, below the usual lower limit of human perception at 4000A.

**Question:** Which wave length is most useful to produce fluorescent responses?

**Answer:** Long wave ultra violet, suitably filtered to exclude visible radiation.

**Question:** Why is a filter necessary?

**Answer:** Specially compounded filters transmit essential "fluorescent" wave lengths, and cut off extraneous visible energy.

**Question:** Why do we see blue light if ultra violet is supposed to be invisible?

**Answer:** We see usually only the result when Black Light impinges on the subject material which, in turn, responds with fluorescence. This fluorescence, in order to be visible, occurs in the region 4000 to 7800A. Filters do not quite cut off sharply at 4000A. Hence we see a small amount of visible violet-blue.

**Question:** What is fluorescence?

**Answer:** Fluorescence is the visible light given off by an object illuminated by black light—the result of a shift in wave length caused by the shorter-than-visible energy reflection being converted to longer wave lengths.

Black-light provides a versatile tool for the arts and sciences—in industry, research, medicine, biology and criminology. Manifold uses are rapidly being extended, new technics devised in many investigative directions—

**Question:** Why are some materials fluorescent and some not?

**Answer:** Some authors attempt to list fluorescent materials, which would fill a large book. For example, in examining a surface to determine whether invisible mold spores have begun their growth, the material ordinarily would be non-fluorescent, but the presence of mold spores causes a pinkish, spotty fluorescence.

**Question:** What are the colors of fluorescence?

**Answer:** Any color of the spectrum or a combination thereof.

**Question:** Is 3660A ultra violet harmful to eyes or skin?

**Answer:** Authorities assert it is not harmful. Complaints against Black Light are usually psychological. Apparent discomfort is caused by natural fluorescence of surfaces of the human eye, causing a sensation of fuzziness, sometimes annoying, but no proof that it is harmful is extant.

### In industry, product inspection and identification is the greatest use of Black Light

Each industry or process develops its own technic. A few uses will exemplify others:—to detect cracks, flaws and other defects in metals, castings, ceramics, and plastics. The part is dipped in fluorescent dye, which penetrates the cracks or fills the flaws. The part is next washed to remove the surface dye, then examined under Black Light. Defects are immediately apparent. Leaks in gas or hydraulic lines can be checked by injecting fluorescing material into the system.

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Fluorescent tracers in powder form may be added to slurries so that the proper coverage of coatings may be later evaluated under Black Light. Powders may be added to rubber compositions or paper pulp.

If invisible marking is desirable to date a production run, as on bags, paper or cloth, invisible inks can be used. These become visible only under Black Light. Black Light applications are infinite, using powders, inks, greases.

#### Uses in criminology

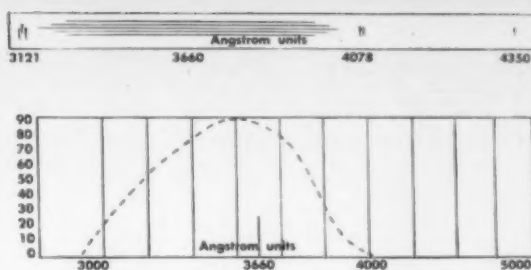
In criminology, fluorescence of parts of the anatomy is used to identify victims of amnesia, or will aid in the identification of bodies. Scar tissue which might be invisible under normal light shows up under Black Light. Outlines of birthmarks or tattoos which may have been removed are often visible under Black Light.

Fluorescent powders are sometimes used to dust valuable merchandise. This powder, normally invisible, will transfer freely to a thief's hands, clothing, or automobile, and examination under Black Light will tell the tale. Fluorescent powders are also used to mark paper money; coins may be marked with invisible fluorescent lacquer.

#### Typical uses in medicine

In medicine, for example, Black Light is employed in urinalysis and other clinical procedures. Fluorescent staining is used in microscopy for tissue differentiation. Fluorescein in the anterior area of the eye provides a rapid means of detecting foreign bodies under Black

Spectrogram of Black Lights. Note broad continuum of radiation, a feature of conversion phosphor-coated source tube. Transmission curve below is for envelope filter used in Black Lights. Note peak at 3660A and cut-off of useless output. Full-filtered HARMLESS radiant energy produces maximum fluorescence response in observed materials WITHOUT head and glare characteristic of other sources.



Light. Corneal lesions, abrasions and ulcers are also easily seen. Many skin conditions or diseases of the skin and scalp are seen more clearly or become visible only under Black Light. Additional data on medical applications is given in Bulletin 542.

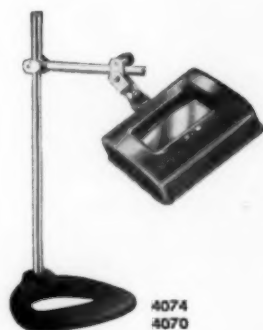
#### Examples of other uses

Stamps, rare books, prints, pictures, may be examined under Black Light, which divulges markings and tell-tale differences, otherwise invisible. Insects examined under Black Light show marked characteristics. Tracer dyes, inks and greases will further aid in entomology, anatomical and physiological studies. Tracing

rodents is done by droppings caused to fluoresce by adding special material into foodstuffs. Introduction of tracer powders into wash waters will help check cleanliness of dishes, pots or pans. Identification of batches of grain and other foodstuffs, by introducing fluorescent tracers, is easily performed.

Prices, lot numbers, special batches, designs on fabrics, dates,—even personnel identity—can be indicated by tracers that become visible under Black Light.

Almost every science is aided by the use of Ultra Violet Black Light, to demonstrate characteristics not seen under visible light. Potential applications are virtually innumerable.



## Data for ordering standard model black lights

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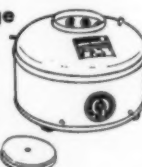
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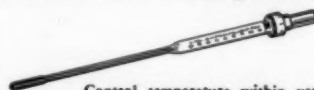


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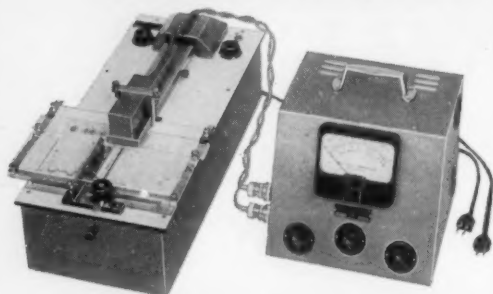
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## Editorial Responsibility

Practically every editorial that has appeared on this page has been criticized by one or more readers. (So far no one has protested our congratulations to *Nature* on the occasion of that distinguished journal's 86th birthday, but there is still time, for that editorial appeared only a short time ago.) Most of the criticisms express a point of view different from that of the editorial writer. Such letters are always welcome, for, if the topic is worth discussing, it is healthy to examine alternative points of view.

A few criticisms are written to correct errors. For example, several weeks ago we chided those few scientists who appear to be overeager for publicity and, in the course of the editorial, mentioned that one newspaper columnist had been critical of the television program *March of Medicine* for what he considered to be sensationalism. It was immediately pointed out to us that a number of other commentators had praised that particular program and that we had quoted only one man's view. This was correct, and if our comment harmed a worth-while program, we apologize.

An occasional letter takes us to task on the ground that no editor should be so presumptuous as to think that he can speak for American scientists. Right; none does. This is the reason why all editorials are signed. The author—sometimes an officer or staff member of the Association, sometimes a guest—speaks for himself. If he says anything of importance, fine; if he is provocative and stirs up a useful controversy, also fine; if he writes drivel or says something that is wrong, the error is his, not the Association's and not science's.

A newspaper can state its editorial opinions anonymously, for it is generally understood that a newspaper expresses the judgment of its owners and editors. *Science*, in contrast, is not a newspaper, and the Association that owns it is not a private enterprise. The Association is 50,000 scientists. Through its affiliates, it is the focus of some 260 scientific societies. Within its membership and its affiliates are many points of view, many interests, and many differences of opinion. On the rare occasions when the Association speaks formally, the statement is prepared by the Board of Directors, the Council, or both, for the formal expression of opinion of the Association should and does carry great weight and must therefore be prepared with great care.

An editorial, however, expresses the opinion of an individual and not of the Association as a whole. The author is responsible for being as accurate as his resources allow. He is responsible for electing topics that are worth discussing. And he should be provocative enough to make readers think about the problems involved in an issue. But he is not the voice of science. When we consider the implications of such a possibility, we can be thankful that he is not.—D. W.




Which of these

# MIND OPENERS

solves your teaching problem?




## BAUSCH & LOMB "FL" MICROSCOPE


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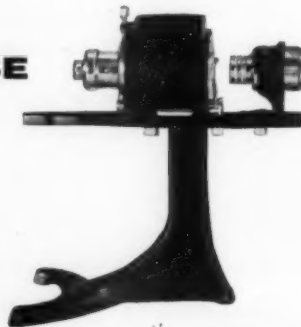


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## Satellite Program

Joseph Kaplan and Hugh Odishaw

The surge of interest in the earth satellite program had its basis in the assemblies of some 40 nations, meeting to plan and integrate the unprecedented study of man's physical environment known as the International Geophysical Year, 1957-58. This world-wide study primarily embraces those fields of geophysics in which observations must be conducted simultaneously over the earth if we are to achieve significant progress in our understanding of the earth and its atmosphere. Problems to be studied include aurora and airglow, cosmic rays, geomagnetism, glaciology, gravity measurements, ionospheric physics, longitude and latitude determinations, meteorology, oceanography, seismology, and solar activity. Two additional areas of activity are of special interest: rocket studies of the upper atmosphere and the recently announced satellite studies, which represent a logical extension, technically and conceptually, of the rocket program.

How the satellite program came into being, the present status of plans, and the type of experiments under consideration are some of the questions of current interest. Since the announcement of the program on 29 July 1955, by the President, questions on these points have been asked often, by scientists and laymen alike. This article attempts to tell the story of the program.

The interest of the U.S. National Committee for the International Geo-

physical Year in earth-circling research satellites began with the adoption of resolutions, during the summer and early fall of 1954, regarding the desirability of such vehicles. These resolutions were adopted by three international scientific bodies: the International Scientific Radio Union, the International Union of Geodesy and Geophysics, and the Special Committee for IGY of the International Council of Scientific Unions (CSAGI). The resolution of most immediate interest is the one adopted on 4 October 1954 by the CSAGI:

"In view of the great importance of observations during extended periods of time of extra-terrestrial radiations and geophysical phenomena in the upper atmosphere, and in view of the advanced state of present rocket techniques, CSAGI recommends that thought be given to the launching of small satellite vehicles, to their scientific instrumentation, and to the new problems associated with satellite experiments, such as power supply, telemetering, and orientation of the vehicle."

In view of these international recommendations, and in view of the advanced state of U.S. rocketry developments, the Executive Committee of the U.S. National Committee for the IGY (USNC-IGY) considered the possibility of constructing, launching, and observing an instrumented satellite. A special group was established for this purpose, composed of various members of the USNC Executive Committee and the USNC Technical Panel on Rocketry.

On the basis of recommendations made by the special study group, the Executive Committee decided that an instrumented satellite program not only

was of scientific importance but was feasible, and it adopted a resolution which reads in part as follows.

"The Executive Committee of the USNC-IGY feels that a small artificial satellite for geophysical purposes is feasible during the International Geophysical Year if action is initiated promptly, and that the realization of such a satellite would give promise of yielding original results of geophysical interest."

The Executive Committee authorized the chairman of the U.S. National Committee to transmit the aforementioned findings and resolution to the president of the National Academy of Sciences and the director of the National Science Foundation. This was done on 14 March 1955.

Meanwhile the scientific and technical studies of the committee's special satellite group continued. By the early part of May, a preliminary program had been developed, and the committee directed its chairman to transmit the proposed program to the Federal Government through the National Science Foundation. This was done on 6 May 1955.

Late in July, the Government's approval of the satellite program permitted the chairman of the USNC to notify the CSAGI of our plans. In his letter of 26 July 1955, to Sydney Chapman, president of CSAGI and one of the world's most distinguished geophysicists, Kaplan said:

"The Committee on behalf of the National Academy of Sciences wishes to inform you at this time that, in response to the CSAGI resolution, the program of the United States for the International Geophysical Year now includes definite plans for the launching of small satellites during the International Geophysical Year.

"The United States National Committee believes that significant scientific data may be gathered as a result of this program in such fields as geodesy, atmospheric physics, ionospheric physics, auroral physics, and solar radiation. The participation of other nations engaged in the International Geophysical Year is invited, and to this end we shall provide full scientific information on the orbiting vehicle so that other nations may monitor the device and make appropriate observations. The United States National Committee looks for-

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ward to the interest and cooperation of other nations in what it hopes will be one of the great scientific achievements of our time."

On 29 July 1955, Chapman released this letter to the public at Brussels through CSAGI's secretary general, M. Nicolet. A few minutes later, the President's endorsement of the program was made public at the White House by James C. Hagerty, the President's press secretary:

"On behalf of the President, I am now announcing that the President has approved plans by this country for going ahead with the launching of small, unmanned, earth-circling satellites as part of the United States participation in the International Geophysical Year which takes place between July 1957 and December 1958. This program will, for the first time in history, enable scientists throughout the world to make sustained observations in the regions beyond the earth's atmosphere.

"The President expressed personal gratification that the American program will provide scientists of all nations this important and unique opportunity for the advancement of science."

Chapman replied to Kaplan on 3 August 1955. The substance of Chapman's letter is contained in the following three quoted paragraphs:

"On behalf of the CSAGI I wish to express great satisfaction that it was in consequence of the CSAGI resolution you quote, that your National Committee arranged for a study of the possibilities and value of the construction of a satellite vehicle for upper atmospheric and other scientific exploration.

"I am glad to know that this study was so successful that your Committee felt able to resolve to construct and launch small satellites as a part of the United States contribution to the International Geophysical Year, and to announce these plans publicly. The long experience of your scientists in rocket launching and construction, and the brilliant scientific use they have made of rockets for upper atmospheric and solar exploration, gives confidence that the plans so announced will be fulfilled.

"This will indeed be one of the great scientific achievements of our time, and will give occasion and opportunity for the cooperation of other nations in this outstanding part of the great enterprise, the International Geophysical Year."

These, then, were the early steps in the development of the academy's satellite program: the international resolutions recommending such an effort; months of preliminary study and planning by the U.S. National Committee for the IGY, culminating in the 10 March basic recommendation of the committee and 6 May program proposal to the

Government; the exchange of letters between the chairman of the USNC-IGY (26 July 1955) and the president of CSAGI (3 August 1955); and the President's endorsement of the program on 29 July 1955, signaling the actual undertaking of the program.

The scientific basis for the satellite program is to be found in the need for basic, directly observed data, which ground-based experiments are unable to provide. The lack of such data is probably the single most important factor accounting for present incomplete explanations and theories regarding such fields as auroral and ionospheric physics.

Rocket soundings of the upper atmosphere have yielded significant results, and the IGY program includes a major rocket research effort. Some hundreds of rockets will be fired during the IGY, ranging from the relatively small balloon or aircraft-launched devices to high-performance Aerobees capable of reaching approximately 200 miles. The results of these experiments are expected to contribute to a better understanding of atmospheric events in two ways: First, rocket observations will provide direct data of various phenomena which can be used, so to speak, to calibrate ground-based observations. The latter, as with ionospheric soundings, provide rather conveniently and inexpensively extensive indirect data. Second, new discoveries may well be made, particularly of events screened by the earth's atmosphere.

Thus rockets permit us to make direct measurements of quantities that are either only indirectly observable or are not observable at all, from the ground. They also provide a technique for measuring the altitude dependence of various geophysical parameters. Unfortunately, rockets have two serious disadvantages: (i) their total flight is extremely short and the time spent in a particular altitude range is even shorter; and (ii) their flight paths are restricted in terms of geographic coverage.

Thus, in spite of the very great value of rocket data, much of which is attainable only by rocket methods, there exists a need for a device that can provide synoptic data over the earth, at high altitudes, over appreciable periods of time. As examples, one can cite the following: fluctuations in such solar effects as ultraviolet radiations and x-rays, cosmic-ray intensities, current rings encircling the earth, and particle streams impinging on the high atmosphere. These and other phenomena are among the most important problems connected with the physics of the upper atmosphere and with solar-terrestrial relationships.

Clearly an earth satellite would permit observations of the kind indicated in the foregoing paragraphs, and the value of these studies convinced the

USNC of the merit of responding to the invitation of CSAGI. In its report last October to CSAGI, the committee indicated that the following types of experiments were under consideration: (i) determination of outer atmosphere densities by observation of the air-drag effect on the satellite's orbit; (ii) obtaining of more accurate measurements of the earth's equatorial radius and oblateness and of intercontinental distances and other geodetic data than are presently available; (iii) long-term observations of solar ultraviolet radiation; (iv) studies of intensities and fluctuations in intensity of the cosmic and other particle radiations impinging on the atmosphere; (v) determination of the density of hydrogen atoms and ions in interplanetary space; (vi) observations of the Störmer current ring; (vii) if possible, determination of the distribution of mass in the earth's crust along the orbital track.

How many and what experiments will be undertaken cannot be specified at this time. In part, these depend on the number, size, and pay-load capacity of the satellites. In part, they depend on choices yet to be made by the USNC, in collaboration with interested scientists, for in all probability more experiments will be proposed than can be fitted into the IGY satellite program.

Work on technical details of the satellite is currently under way. Information now available may be stated briefly: the satellites will be small; they will contain scientific instruments; they will be trackable from ground by optical and radio techniques; they will probably be visible to the naked eye under optimum conditions at dawn and dusk and certainly observable under good atmospheric conditions by means of binoculars and wide-field optical equipment.

In size the satellite may be described as about that of a basketball, although the shape has not yet been fixed. Each satellite will weigh more than 20 pounds but probably less than 50 pounds. The satellite will travel about the earth in an elliptical orbit, with a perigee distance of at least 200 miles and an apogee distance of some 800 miles. It is expected that the satellite will remain in its orbit for at least several weeks and perhaps for months: the greater perigee and apogee distances, the longer the life of the satellite as a result of reduced atmospheric resistance. The velocity of the satellite will be approximately 18,000 miles per hour, giving a period of about an hour and a half, depending on the precise perigee and apogee values.

The Government's endorsement of the academy's satellite proposal permitted the committee to proceed beyond the preliminary plans outlined in its 6 May document. Whereas the studies of the committee had been conducted on an ad

hoc basis, calling upon members of the USNC Executive Committee and the Technical Panel on Rocketry, as well as various consultants, it now became appropriate to establish a Technical Panel on the Earth Satellite Program. The membership of this panel is as follows: R. W. Porter, chairman (consultant, Communication and Control Equipment, Engineering Services Division, General Electric Company); Hugh Odishaw, secretary (executive secretary, U.S. National Committee-IGY, National Academy of Sciences); Joseph Kaplan (professor of physics, University of California at Los Angeles; chairman, U.S. National Committee-IGY, National Academy of Sciences); H. E. Newell, Jr. (acting superintendent, Atmosphere and Astrophysics Division, Naval Research Laboratory); W. H. Pickering (director, Jet Propulsion Laboratory, California Institute of Technology); A. F. Spilhaus (dean, Institute of Technology, University of Minnesota); Lyman Spitzer, Jr. (professor of astronomy, Princeton University); J. A. Van Allen (professor of physics and head of department of physics, State University of Iowa); F. L. Whipple (director, Smithsonian Astrophysical Observatory; professor of astronomy and chairman of the department of astronomy, Harvard University).

The functions of this panel are analogous to those of the other 12 technical panels of the USNC in the various IGY disciplines. The Technical Panel on the Earth Satellite Program, with such additional membership and consultants as are necessary, will have fundamental responsibilities, acting on behalf of the USNC, in further developing, coordinating, and directing the over-all scientific satellite effort. The panel expects to utilize contributions from many scientists and institutions, a feature that has characterized the planning of all IGY programs under the auspices of the USNC.

At the same time, the Government's support made it desirable to begin certain technical phases of the effort immediately if launchings were to be realized as early as possible during the 1957-58 IGY period. The committee had taken cognizance, in its 6 May proposal, of the need for logistic support from the Department of Defense: only through the use of this agency's facilities and rocket experience could the program be attempted economically and realistically. Accordingly, the committee called for this type of assistance.

In making this request, the committee had two major precedents: first, the

Antarctic Program which requires extensive expeditionary and logistic support and, second, the rocket program. In both of these areas, the Department of Defense has responded and is making substantial contributions to the IGY program.

Following the President's approval on 29 July the committee's request for logistic support in the satellite program was granted. This support will be provided jointly by the three military services under Navy management. A group has already been established, directed by John P. Hagen of the Naval Research Laboratory, for the conduct of Project Vanguard, the name assigned to Defense's effort. Two contracts have already been issued for propulsion rocket vehicles, and Project Vanguard will conduct the operations necessary to get the satellite on orbit, following much the same pattern established for the IGY rocket program.

The satellite program, then, is already under way. Although it is clearly an exciting and significant endeavor, one should not lose sight of the difficulties of the enterprise. The committee's studies indicated that existing rocket technology provided a sound basis for the feasibility of the proposal. Yet the venture is truly a pioneering one, and partly for this reason the committee's 6 May document called for some ten instrumented satellites, with the hope that at least five or six would be successfully launched into their orbits.

The growing realization of the technologic feasibility of a satellite endeavor in recent years provided the impetus to international considerations of such a program. The German V-2 rocket developments of World War II, the high-atmosphere research rockets (for example, the Aerobee and the Viking) of the United States, and related rocket efforts of other nations created a body of literature and a technology that provided the foundations for a new departure. During the last decade or so the concept of small, research satellites for study of the high atmosphere has occurred to many thoughtful individuals. Members of the Upper Atmosphere Rocket Research Panel, an informal group of leading U.S. rocket and upper atmosphere scientists and engineers, have considered just such prospects. One of the most widely publicized recent proposals was that of S. F. Singer's MOUSE.

Such, then, was the climate at the Rome meeting in the autumn of 1954 when representatives of various nations met to coordinate the IGY programs,

and out of it grew the CSAGI resolution advocating the satellite venture. This venture not only has grown out of the world-wide IGY Program but is a substantial and promising part of it. The intensity of effort to be devoted by more than 40 nations, investigating phenomena in some 12 geophysical disciplines, is augmented now by the results that the satellite program promises: observations of high atmospheric and interstellar events unhindered by the earth's lower masking atmosphere.

In this venture, other nations and other observers will share, for, as the President indicated, the satellite will be public. Its design and instrumentation will be made known. The frequencies of the telemetering system, which will radio back to earth the scientific observations, will be revealed. The results of observations will be published. These provisions, in keeping with the peaceful and cooperative spirit of IGY, will permit the satellite to be followed and observed throughout its course about the earth.

One year after the Rome meeting and some 2 months after the President's announcement, the nations of the world met again at Brussels, to integrate further their respective IGY efforts. The inspiring character of the President's announcement was clearly revealed. The scientists of the 40 or more other nations participating in the IGY received the news of the proposed U.S. satellite program enthusiastically. This reception was based in part on the great admiration by scientists of other countries for the past achievements of American rocket scientists. More important, however, this reception was based on the knowledge that the value of geophysical observations made during the IGY would be enhanced greatly by the addition of extensive, direct data obtainable only from research satellites.

Participation of scientists in this endeavor falls within the purview of the National Academy of Sciences, which established the U.S. National Committee for the IGY. This committee, with its subcommittees and panels, is charged with responsibilities for planning, directing, and executing the U.S.-IGY effort. The Government has cooperated extensively in the realization of the program, both program-wise and fiscally. The National Science Foundation, at the request of the academy, has assumed responsibility for the fiscal aspects of the program and has played a major role in the coordination of Government interests. Federal funds totaling \$12 million have already been appropriated for the over-all IGY effort.



# Status of Storm-Tide Research

Robert O. Reid

Because of the importance of the problem of forecasting high water levels that accompany hurricanes at coastal stations, I feel that some general remarks about the status of storm-tide research would be of value in stimulating further research. The aim of this paper (1) is not to give a comprehensive résumé of all work done to date on the subject of storm tides but to attempt to define the general problem and to point out some specific questions that require answers if an adequate prediction of storm tides is to be achieved.

## General Problem

The quantitative investigation of any natural phenomenon demands an adequate definition. In the storm-tide problem, we require a statement of scope because water-level variations in general are characterized by a diffuse power spectrum that covers an extremely broad range of periods—from fractions of a second to many years. Of the entire spectrum, the astronomical tides and seiches (2) are evidently the only phenomena in which the power is concentrated in a finite number of discrete periods. Ordinary surface waves and swell cover a rather broad range in which the power is evidently continuous but does possess blurred peaks that characterize the particular generating factors. We know less about the intermediate range of periods between those of swell and astronomical tides, but we do know that such phenomena as surf beat, edge waves, tsunamis, and storm tides occur in a diffuse and overlapping manner within this range. Storm tides no doubt overlap the periods of ordinary astronomical tides as well.

As a working definition, one might define storm tides as those disturbances of water level exclusive of (i) ordinary surface waves, ripples, and swell; (ii) tsun-

amis and other anomalies of water level associated with molar disturbances of the earth; (iii) surf beat associated with the irregularity of the net shoreward transport of water by ordinary surface waves and swell in the surf zone; (iv) astronomical tides; (v) variations in water level resulting from water density changes by thermal processes or from redistribution of mass associated with modifications in the quasigeostrophic circulation of the oceans (owing to changes in the vorticity of the zonal wind field of oceanic scale); and (vi) ultralong-term variations in apparent water level of geological nature such as may result from subsidence and other causes. Seiches, on the other hand, are considered as part of the storm-tide problem and represent merely the natural mode or free forms associated with the dynamic aspect of the problem for a particular basin.

In short, this implies that storm tides represent those nonastronomical anomalies of water level that result from the winds, from abnormal atmospheric pressure, and from excessive precipitation caused by local storms, excluding ordinary wind wave "noise" and phenomena directly associated with such waves.

This definition is very useful in the formulation of the problem from a mathematical standpoint. From the standpoint of comparison of theory with observation, it is necessary that the appropriate unwanted vibrations be filtered out of the total water-level variation that occurs. By and large, an ordinary float in a still-well type of water-level recorder with a suitable orifice will filter out all ordinary waves and swell and perhaps much of the surf beat, which is probably of low power anyway. There is no formal difficulty in extracting the astronomical tides, and for East Coast and Gulf of Mexico stations, the occurrence of tsunamis seems improbable. This leaves items (v) and (vi) superimposed on the storm-tide data. The first of these is probably of negligible magnitude but can be evaluated, if the question arises, through oceanographic measurements in the deep water offshore. The second can certainly

be regarded as negligible for the time that it takes a storm to pass a particular site.

Storm tides, like swell and astronomical tides, are basically gravity wave phenomena and therefore must involve some consideration of the dynamic effects associated with the movement of water (3), as well as consideration of the driving forces. Unlike swell, the storm tides can be considered as of long wave length compared with depth, and they are not entirely free waves. Like astronomical tides, the storm tides are long forced waves, but the driving force occurs at the surface of the water rather than on the entire mass of water itself.

In certain very special circumstances, a condition of (at least) quasisteady state—in the presence of the primary forces (wind stress and atmospheric pressure)—may be achieved and the problem becomes one of computing the "wind set-up" and/or "inverted-barometer" effect. In other special circumstances, the equilibrium may be one of balance between the pressure gradient, which is associated with the slope of the surface, and one or more of the secondary or dynamic forces that are associated with the motion of the water. The latter would be free waves, either standing or progressive, and are damped or not depending on whether or not bottom friction is present. One can visualize many other special cases; however, these two seem to serve as useful limiting cases.

The first of these special cases has been employed almost exclusively in past work pertaining to the problem of relating wind speed to water surface slope in lakes and bays (4). Needless to say, one should be cautious in accepting the results of such studies and should make sure that the conditions of quasisteady state were in fact realized. Attention to such matters does not seem to have been stressed until recently (5).

In the general problem, the storm-tide phenomenon is neither one of static equilibrium nor one of free gravity wave motion, nor is it a simple linear combination of these two limiting cases. This is one of the basic difficulties in attempting to establish a practical method of storm-tide prediction that will cover all the possible situations that may arise. The reason the forecasting of ordinary waves and swell has succeeded as well as it has is that one deals with the transformation of *free waves*, the initial heights of which are described in statistical terms—that is, on a probability basis—essentially through empirical formulas. The storm tide on the other hand must be considered in more detail than that involved in merely prescribing such quantities as a "significant" height and period. An accurate prediction of the entire time history or at least the maximum height

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to be attained at the site considered, under given storm conditions, is necessary if the method is to be successful.

The generation of a storm tide by the action of the wind depends rather critically on depth. This suggests a further inherent difficulty in the storm-tide prediction. The scale or effective wave length of the storm tide will be comparable to that of the storm fetch; thus an extreme range of depths may exist over the length of the wave. Consequently, even if the waves were regarded as free, the conventional methods of shoaling and refraction as employed in ordinary swell would not be applicable.

The 11 factors that must surely play a role in the determination of water level are as follows. (i) The depth of water, including the normal tide and the storm tide itself. Mean depth is in general a function of both of the horizontal coordinates, and the total depth is dependent on time in addition. (ii) The nature of the basin of water—whether it is enclosed or is in open communication with the deep sea. (iii) The scale of the storm relative to the scale of the basin of water. (iv) The wind velocity (both speed and direction) and its variation with space and time. (v) The atmospheric pressure and its variation with space and time. (vi) The velocity of propagation of the storm. (vii) The relationship between the wind stress and the wind speed and the stability of the air. (viii) The bottom friction associated with the flow of water; the nature of the bottom material. (ix) The inertial force associated with the acceleration of the water. (x) The deflecting force associated with the rotation of the earth (this may be of importance for large-scale disturbances on an open continental shelf). (xi) Rainfall (probably minor except over land areas).

### Present Status of Research

There are two natural avenues of attack on the problem of storm-tide prediction that have been pursued in the past. These are (i) numerical analysis of existing measurements of storm tides and storms for a given site in the attempt to devise an empirical prediction technique that is statistically significant and (ii) mathematical analysis of assumed physical models where the formulation of the problem involves simple conditions on a number of the variables in order that a solution can be achieved. Some such special cases can be checked against existing data in those cases in which the conditions of the theoretical model are satisfied to a certain degree.

Many of the theoretical cases treated to date deal with conditions that are so restrictive that they are of virtually no value in prediction. A great deal of the

literature on the subject, for example, deals with forced and/or free waves in a canal of constant depth and infinite length. Such one-dimensional problems yield interesting results, but they are applicable to real problems only in a qualitative sense if at all. In those few cases in which two-dimensional problems have been considered, certain important features of the behavior of the fluid are revealed that do not have any counterpart in the one-dimensional problem. This is particularly true of certain resonance phenomena.

The problem of the forced surge in a long canal of constant depth, which was investigated by J. Proudman (6), is one of the more elegant of the existing theories because of its simplicity. However, the criterion of resonance that is predicted by the theory, that the Froude number

$$V/\sqrt{gh}$$

be unity is hardly of any use when the depth  $h$  varies in the direction of the velocity of the storm  $V$ .

Among the more sophisticated mathematical theories on the subject, we find two dimensions considered with traveling storms, but again the depth is held constant right up to the shore, which is a vertical sea wall. Most of the more practical theories treat the problem by numerical solution; in so doing they are capable of considering such complications as actual bottom topography, but they are not capable of treating some of the important features involved in resonance phenomena. The theoretical work thus far completed has merely scratched the surface so far as our basic understanding of the real storm-tide problem is concerned.

From both the mathematical and physical standpoints, the general storm-tide problem falls into one of the following two broad categories: (i) Storm tide rise small compared with the normal depth, and (ii) storm tide rise represents a significant fraction or even exceeds the normal depth (such as near a sloping beach).

In the first case, the mathematical problem can be linearized and the general problem of the forced water level disturbance is formally capable of solution by the standard procedure of normal modes provided that the boundary conditions and forcing functions are specified. This involves first solving for the two-dimensional natural modes (or "seiche" modes) of the basin and then expressing the space variation of the forcing functions in terms of these natural modes and solving for a set of time-dependent coefficients. This leads to a solution in series form from which numerical values may be quite difficult to achieve. Only in certain special cases can a closed-

form solution in terms of tabulated functions be achieved. However, a number of such special cases are important with respect to the variety of the results thereby achieved.

In the second case, the mathematical problem is nonlinear, and no general method for analytic solution exists. Certain special cases in this group are susceptible to treatment by the method of characteristics as used in gas dynamics and shock-wave theory, but this procedure has definite limitations. The only general procedure is that of some numerical method of solution employing finite difference equations. Here one must be guided by certain criteria concerning the stability of the numerical process in order to assure that the level of error involved does not exceed prescribed bounds. The numerical procedure indicates the use of high-speed computers for obvious reasons and suffers from the inability of achieving a compact analytic solution that indicates the role played by each of the independent variables considered (unless a considerable amount of computation is carried out).

### Storm-Tide Behavior

In a lake the principal dynamic action manifests itself in the formation of a seiche superimposed on the forced wind set-up. The latter will have a value that depends on the rate at which the wind is varying. If the effective period of the variation of the mean wind is of the order of the natural frequency of the lake or bay, then a resonance can exist and the amplitude of the wind set-up can build up to a value many times the steady-state value under a sustained wind of the same magnitude. However, this requires several repetitions or cycles in the forcing agent. For the case of the passage of a single storm, where only one cycle is accomplished, the forced dynamic set-up may be of the same order as the steady wind set-up under conditions of the peak wind in the storm. Perhaps a more effective dynamic effect in a small lake would occur when the wind increases over the whole lake very suddenly and is thereafter sustained for many hours (such as may occur with a rapidly moving large hurricane). In this case the water level will rise at one end to a value that is about twice the steady-state value corresponding to the same wind, provided that the wind is sustained long enough. This is the result of the joint action of the forced and free seiches induced by the wind.

Over a continental shelf or bay that is in open communication to the sea, a greater steady-state water level can result than that in a lake or other small enclosed body because of the additional

water transported into the area in question from the virtually unlimited supply of the open sea. That is, in a lake (of constant depth, for example) a uniform steady wind will produce a set-up of  $S$  feet at the downwind end and a lowering of water of  $S$  feet at the upwind end. On the other hand, in a bay of the same length and same constant depth subject to the same steady wind, the water level can be twice the value at the head of the bay (assuming that the wind is directed toward the head of the bay). Furthermore, on a very expansive continental shelf, the greater fetch of water under the action of the wind can lead to greater water level.

### Important Questions

Some of the important questions that must be answered before an adequate

prediction scheme is developed follow.

(i) Under what conditions of the scale and intensity factors is it possible for the dynamic aspects of the water-level problem to become a significant part of the total storm tide? (ii) Under conditions where quasistatic conditions are nearly realized, how important are the two-dimensional aspects of the circulation of water (considering bottom friction) in governing the longitudinal and transverse gradients of water level? (iii) In the case of large scale storms on an open coast or over a moderately large basin such as the Gulf of Mexico, how important is the influence of Coriolis force in balancing the gradients of water level induced by the wind and atmospheric pressure anomalies? (iv) In determining the water level rise on a beach, what are the principal forces involved? (v) How important are the nonlinear aspects of the problem? Under what conditions can an abrupt

free surge develop? (vi) Of greatest importance is the question of the appropriate boundary conditions to be imposed at the coast for a gradually varying bottom slope terminating in a beach with no cliffs or sea wall at the shore.

### References and Notes

1. Contribution from the department of Oceanography of the Agricultural and Mechanical College of Texas, Oceanography and Meteorology Series No. 56. This paper is based on investigations conducted for the Texas A and M Research Foundation through the sponsorship of the Office of Naval Research.
2. Seiches are free standing waves in an enclosed or partially enclosed basin having a discrete spectrum.
3. The dynamic effects envisaged here include those associated with inertial force, Coriolis force, and frictional force. All of these are directly related to the motion (velocity and/or acceleration) of the water.
4. Actually this is one mode of attack on the problem of evaluation of the surface-resistance coefficient for wind stress.
5. B. Haurwitz, *Beach Erosion Board Tech. Memo. No. 25* (1951).
6. J. Proudman, *Dynamical Oceanography* (Wiley, New York, 1953), pp. 295-301.

## Amendments to the AAAS Constitution

Dael Wolfe

At the 1953 meeting of the Association, the Council authorized appointment of a Committee on Constitution, Bylaws, and General Operations to review the Association's constitution and bylaws and to recommend appropriate changes. The committee consists of Wallace R. Brode, chairman, Roger Adams, Meredith F. Burrill, Clarence E. Davies, and Milton O. Lee. Howard A. Meyerhoff and Dael Wolfe serve as advisers to the committee.

Amendments recommended by the committee were considered by the Board of Directors during their meeting 29-30 October. The board approved the committee's recommendations, with a few changes and additions, and authorized their submission to the Council at the annual meeting of 1955.

The constitution requires that proposed amendments be published in substance in *Science* and *The Scientific Monthly* at least a month before the Council meeting at which they are to be considered. Accordingly, the more im-

portant of the proposed amendments to the constitution are described in the following section. The next section lists several additional changes that are being recommended to clarify intent, remove ambiguities, or improve current practices.

### Constitutional Changes

**Article IV.** A quorum now consists of 20 members and the signatures of 20 members are required to call a special meeting of the Council. In both cases it is recommended that the number be increased to 30.

Ordinarily each Council member has one vote, but in a few cases a member represents two or more affiliated societies and the number of votes to which such members are entitled has not been clear. It is recommended that each member have only one vote.

The president presides over Council meetings. If the president is absent, the constitution provides for the election of a

chairman by the Council. It is recommended that the president elect serve in the absence of the president.

**Article VI.** A section committee now includes representatives from societies affiliated with that section and other Council members whose own scientific interests lie in the field of the section. Thus, some affiliated societies, such as state academies of science, may one year be represented in one section committee and the next year in another. It is recommended that representatives of societies that are not affiliated with a section that has a section committee not be made members of a section committee. If adopted, this change will mean that a society may be affiliated with one or more AAAS sections, that its representatives will serve as members of the section committees of such sections, but that the representatives will not be assigned to other section committees. To provide greater flexibility and to permit overlap of membership on section committees, it is recommended that the prohibition against serving on more than one such committee be abolished.

**Article VIII.** Affiliated societies have one or two representatives in the Council, depending upon the number of their members who are fellows of the AAAS. State academies of science have for some years been an exception to this rule, for regardless of size they have only one Council representative. It is recommended that this arrangement be continued and that it be specified in the constitution.

In order to make formal provision within the Association structure for such

agencies as the Gordon Research Conferences, it is recommended that a new section 4 of article VIII be adopted to establish a class of "participating organizations." Participating organizations are defined as ones whose activities are planned and directed in close association with those of the AAAS. To acquire the status of a "participating organization" will require approval of both the Board of Directors and the Council. Such organizations will be given representation in the Council as determined by the Board of Directors and the Council.

*Article XII.* The present amendment procedure is ambiguous, names the Board of Directors as the only agency with authority to initiate amendments, and does not provide any means whereby the Council can amend the constitution over the objection of the Board of Directors. It is recommended that a vote of the Council or a petition signed by 30 members of the Council also be authorized as means of proposing constitutional amendments. It is further recommended that the Council be given authority to adopt an amendment that is not approved by the board. To do so, under the proposed amendment, would require a majority vote of the Council at one meeting to place the proposed amendment on the agenda of a subsequent annual meeting, and for adoption would require a two-thirds vote of the Council at that subsequent annual meeting.

#### Changes of Detail

The Board of Directors recommends that the title of the administrative secretary be changed to executive officer, and that the corresponding change of word-

ing be made throughout the constitution and bylaws.

*Article II.* It is recommended that only individual members—not institutions and organizations—be eligible for election as fellows.

It is recommended that the word *his* be inserted just before the last word of sections 5(a) and 5(b).

In section 5(c) it is recommended that institutions or organizations—as well as individuals—be given the right to establish and name sustaining memberships and to name the first incumbent of such memberships. It is further recommended that the board be given discretion as to the continuation of a sustaining membership after the death of an incumbent.

*Article III.* It is recommended that the term of office of the president elect and of the vice presidents be defined as 1 year.

It is recommended that the titles of assistants to the administrative secretary not be stated in the constitution but be left to the discretion of the Board of Directors, and that the board be authorized to designate which assistants shall be classed as administrative officers of the Association.

*Article V.* To avoid possible ambiguity, it is recommended that there be a slight rearrangement of the material of section 2. It is recommended that a quorum of the Board of Directors be changed from five members to six voting members. It is further recommended that the term of office of each member continue until his successor shall have signified in writing his acceptance of office.

*Article VI.* In the event of the death or resignation of an elected member of a section committee, it is recommended that a successor be elected by the section

committee instead of by the Board of Directors.

*Article XI.* In order to avoid confusion with other meanings of the term *trust funds*, it is recommended that this classification of the Association's funds be renamed *endowment, trust, and gift funds*.

*Article XII.* It is recommended that a new article XII be adopted, specifying that Roberts' rules of order, except when inconsistent with the constitution or bylaws, shall govern meetings of the Council.

It is recommended that the current article XII be renumbered XIII and that, in addition to the changes in amendment procedure already described, the language specifying that proposed amendments be published in *Science* and *The Scientific Monthly* be replaced by the more generally stated requirement that amendments be officially published.

*All articles.* It is recommended that all articles be given short titles, such as *purpose, membership, officers*, and so forth.

#### Procedure

In advance of the 1955 Council meeting, members of the Council will be mailed copies of the constitution, and also of the bylaws, with the recommended changes indicated in detail. The Council will vote on these matters at the 1955 meeting. If the changes are approved, the revised constitution and bylaws will be published in *Science* and *The Scientific Monthly* early in 1956.

*This statement is also being published in December issue of The Scientific Monthly.*

*The child grows, but is still an experimenter: he grasps at the moon, and his failure teaches him to respect distance. At length his little fingers acquire sufficient mechanical tact to lay hold of a spoon. He thrusts the instrument into his mouth, hurts his gums and thus learns the impenetrability of matter. He lets the spoon fall, and jumps with delight to hear it rattle against the table. The experiment made by accident is repeated with intention, and thus the young student receives his first lessons upon sound and gravitation. There are pains and penalties, however, in the path of the enquirer: he is sure to go wrong, and Nature is just as sure to inform him of the fact. He falls downstairs, burns his fingers, cuts his hand, scalds his tongue, and in this way learns the conditions of his physical well being. This is Nature's way of proceeding, and it is wonderful what progress her pupil makes.—*  
JOHN TYNDALL, *Fragments of Science*, vol. 1, p. 283.

## News of Science

### Restoration of Mayan Tikal

The city of Tikal, Guatemala, largest and possibly oldest site of Mayan civilization, will be explored and partially restored by the University Museum of the University of Pennsylvania. Froelich G. Rainey, director of the museum, says that the project is intended to make Tikal the "finest architectural monument of American Indian civilization available to the public." Under an agreement with President Carlos Castillo Armas of Guatemala, work will start approximately 15 Jan.

Tikal, deep in the rain forests of the Peten region and virtually deserted for nearly a millenium, is a foliage-covered metropolis of skyscraper temples, lavish palaces, dwellings, paved expressways, and long-dry reservoirs. Occupied for 2000 to 3000 years up to about the 10th century A.D., Tikal was rediscovered about a century ago, but was accessible only by mule-back until the Guatemalan Air Force built a nearby landing strip 5 years ago.

In the meantime, other parts of the Peten region had been explored by the Carnegie Institution of Washington, which excavated at Uaxactun from 1926 to 1937, and the University Museum, which worked at Piedras Negras for 10 years beginning in 1930. Their findings pointed to Tikal as the greatest of ancient American cities and the dominant center of Mayan history.

Accordingly, the Carnegie Institution in 1937 made a survey at Tikal, looking toward a restoration such as that now planned. With the new airstrip bringing Tikal within an hour's flight of Guatemala City, the project became feasible.

The University Museum will spend its first season at Tikal setting up adequate living and working facilities and clearing paths to enable archeologists to select structures for restoration. The major archeological work will start in about a year.

John Dinick, research associate for the museum and heretofore director of its expedition to Memphis, Egypt, is director of the Tikal project. Edwin M. Shook, on loan from the Carnegie Institution of Washington, is field director. Linton Satterthwaite, curator of the

American section of the University Museum, is chief archeologist. In the early stages, a native labor force will work under Shook's direction.

Five great temples and dozens of smaller ones dominate the city center. In the style of the Mayan builders, the shrinelike temples rise from stepped, pyramidal platforms and are capped by exotic carvings. One of the temples is as tall as a 20-story building.

Two of the largest temples flank a 350-foot plaza. On another side of the plaza, a group of sculptured and inscribed stone monuments stands before a cluster of the smaller temples. Linking the central area with outlying sections of the city is an elaborately constructed network of causeways—graded roads that are comparable in principle to modern expressways.

### Atomic Structure

For the first time, the atomic structure of a surface may be seen clearly through a field ion microscope. The instrument used was developed by Erwin Muller, professor of physics at Pennsylvania State University, who reported his work in a paper that he delivered at the 13th annual meeting of the Electron Microscope Society of America.

Muller developed the first field electron microscope in Berlin in 1936. In 1951 he modified this microscope to operate with ions, and it was with this instrument, further perfected, that he finally made the new field ion microscope. Heretofore Muller's most efficient microscope presented only blurred pictures of some large-size atoms widely scattered over a surface, but now all the atoms that constitute the surface of a specimen are clearly visible.

Muller's newest field ion microscope operates with a field strength of 5 million volts per centimeter. Built entirely of glass, it contains sealed-in wires used to apply up to 30,000 volts.

The instrument resembles two thermos bottles, one inside the other. It is heavily insulated to preserve the low temperatures—for example,  $-300^{\circ}\text{F}$ —that are necessary for good microscope resolution.

Within the vacuum is a fine tungsten wire, its tip coated with the substance to be studied. The surface of the tip is shown on a fluorescent screen. The metal tip cannot be seen through an ordinary optical microscope. Helium is used to make the ions, which in turn produce the image on the fluorescent screen.

### News Briefs

■ The Political Committee of the United Nations General Assembly has voted unanimously to establish an international scientific body to study the effects of atomic radiation on man's health and environment.

The committee voted 59 to 0 to adopt a much-revised resolution, sponsored by the United States, Britain, and six other nations. However, there was one major amendment; this provides for the expansion of the scientific committee that will make the study from 11 members to 15.

■ RICHARD E. BYRD, retired rear admiral, has been put in charge of all United States antarctic activities. Navy officials have commented that a Presidential directive, in the form of a letter to Byrd, will eventually place the United States on the same footing as Chile, Argentina, Great Britain, and Australia, the countries that maintain permanent bases in Antarctica. The directive outlined the following program:

Byrd will be "charged with maintaining effective monitorship over those political, scientific, legislative, and operational activities which comprise the total United States Antarctic program."

Byrd will act as adviser to the Operations Coordinating Board of the National Security Council on the preparation and execution of antarctic policy. The board has the responsibility of making sure that Presidential directives are properly carried out.

Byrd will assist the Secretary of Defense and other officials in the development of legislation related to antarctic activities.

A permanent unit for antarctic activity will be established, with Byrd coordinating the activities of all particular governmental departments.

Byrd has left for the antarctic to assume supervision of the first phase of a 4-year expedition that got under way with the recent departure of the icebreaker *Edisto* from Boston, Mass. The lead icebreaker, the *Glacier*, sailed a little later from Norfolk, Va.

George J. Dufek, a rear admiral and an antarctic veteran, is in direct command of the expeditionary task force of 1800 men, three icebreakers, one tanker, two auxiliary tankers, and three cargo vessels. The expedition has been designed



nated Operation Deepfreeze. In the first phase of its work the task force will prepare bases and supply facilities to be used by the United States in its contribution in the International Geophysical Year.

■ Axel Wenner-Gren, donor for the Wenner-Gren Foundation for Anthropological Research, New York, has announced a gift of 5 million kroner for the establishment of a new 10-million-kroner scientific center in Stockholm, Sweden. The remaining 5 million kroner will be obtained through a mortgage on the building; the Swedish Government has promised to donate a site for the project. Wenner-Gren commented that the contribution should be regarded as a step in the expansion and continuation of his donation program.

Purpose of the new scheme is to encourage collaboration between Swedish and foreign research workers (with emphasis on the Nordic area) by affording accommodation to approximately 100 foreign scientists in a building that will be named the Wenner-Gren Center for Scientific Research. Ten of the 18 stories of the building will be used as exhibition and office premises, both for the Wenner-Gren Foundation and for manufacturers of technical and scientific apparatus, making it possible for scientists to rent apartments at extremely low rates.

The building will also comprise conference rooms, a library, auditorium, lecture halls, a restaurant, and so forth. Construction is expected to be complete within 2 years. The plan for the center was devised by a board consisting of Siegbahn, Theorell, and Nilsson of Stockholm, Bohr of Copenhagen, Virtanen of Helsinki, and Nicolaysen of Oslo.

■ The Atomic Energy Authority of Great Britain has pointed out in its first annual report that the primary threat to fulfillment of its programs on schedule is lack of skilled manpower. The report comments that the difficulty of recruiting and retaining sufficient numbers of skilled scientists, engineers and craftsmen has been "acute throughout the ten years of the project and shows no signs of becoming easier."

The report noted that the authority is in competition with industry. Because it is dependent on public funds, the authority does not have the same freedom of maneuver as industry in the matter of salaries.

The report covers the period from 19 July 1954 to 31 Mar. 1955. During that period the British Government announced a 10-year program for building 12 electric power stations to be run by nuclear energy. It also disclosed its decision to proceed with the development and production of thermonuclear weapons.

■ The United Nations Food and Agriculture Organization proposes to embark on a new survey of the world's food resources. The object, which was outlined on 7 Nov. to delegates from 71 nations that were attending the tenth anniversary meeting in Rome, is to see whether or not there is enough food for a world population that is growing at the rate of 100,000 daily.

The survey would go into many unexplored fields. One would be the possible use of great land areas not now used for growing food, especially in the tropics and in semiarid regions.

■ The newly ratified Convention on Great Lakes Fisheries brings under a joint United States-Canada conservation program perhaps the greatest fresh-water fisheries anywhere in the world. The convention provides for the establishment of the Great Lakes Fishery Commission, which will be composed of six commissioners, three from each government. This body will seek the preservation and improvement of the lakes fisheries through dual activities in the fields of fishery research and sea lamprey control.

In research, the commission has the duty of coordinating the scientific activities of all agencies engaged in scientific study of lakes fisheries—the United States and Canadian Governments and the conservation departments of the eight Great Lakes states and the Province of Ontario. The convention thus provides machinery for the pooling of the efforts of all fishery experts in the area and the coordination of their research.

The commission will have no power to regulate fishing operations. It can, however, recommend conservation measures to the party governments on the basis of its scientific findings.

The second major responsibility of the commission is to destroy the parasitic sea lamprey. The lamprey has proved to be a scourge to the trout and whitefish of the upper lakes, having already destroyed those species in Lake Huron and Lake Michigan. Lake Superior fisheries are now also under serious attack.

The commission has wide powers in the field control of the lamprey. It is expected the commission will make extensive use of electric barriers which, placed across spawning streams, prevent the lampreys from going upstream.

■ A comprehensive appraisal of progress in cancer control in the last 10 years will be made by 50 American and European scientists. As outlined by the American Cancer Society, the group of scientists will work in three committees, each studying one area of research.

The purpose of the survey is to find the most promising directions for future

research. The organization of the study, as set up earlier this year by the society's directors, provides for the following three committees.

One committee to determine where medical science stands today in its search for more effective control of cancer.

A second committee to consider whether research support to scientists and institutions from funds contributed by the public is sufficiently broad and flexible to assure maximum progress and to enlist and maintain the most imaginative and creative intellects in the field of cancer.

A third committee to plan research in lung cancer, an endeavor for which the society has allocated \$1 million in 1956.

■ The United States and the Soviet Union have reached an agreement on the exchange of medical films. The exchange plan arose from discussions held between Paul W. Schafer, of Walter Reed Hospital, Washington, D.C., and B. V. Petrovsky, member of the Soviet Academy of Medical Sciences, during an international meeting that took place in Washington last year. In the initial exchange each country will make available ten technical films on medical subjects.

■ First-year results from research in a psychological testing program for pre-medical students at the University of Texas Medical Branch "look successful," according to D. Bailey Calvin, dean of students. The 5-year research program, financed by a grant from the Josiah Macy Jr. Foundation, is developing psychological tests to determine in advance a prospective medical student's emotional stability and the strength of his desire to study medicine.

## Scientists in the News

JAMES M. MITCHELL, formerly assistant to the director of the National Science Foundation, has been named associate director of the foundation. Mitchell was Deputy Assistant Secretary of Defense prior to joining NSF, and from 1948-1953 he was U.S. Civil Service Commissioner.

JOHN T. WILSON, who has been serving as program director for psychobiology at NSF, has been appointed assistant director for biological and medical sciences. Previously Wilson spent two years as head of the personnel and training research branch at the Office of Naval Research.

CHARLES A. COULSON, Rouse Ball professor of applied mathematics at Oxford University, England, has won the \$500 Lecomte du Nouy award for his book



*Science and Christian Belief*, a volume that is based on a series of lectures delivered in 1954 at the University of North Carolina.

Established to honor the memory of the late Pierre Lecomte du Nouy, French biophysicist and author, the award is presented annually to the author of a book of spiritual thought that is appropriate to the present age of scientific achievement.

FRANK J. BINGLEY, color television research engineer of the Philco Corporation, has been named to receive the 1956 Vladimir K. Zworykin Television Prize award. He is being honored by the Institute of Radio Engineers for his contributions to colorimetric science as applied to television.

JACK E. BRIDGES, research engineer of the Zenith Radio Corporation, will receive the Browder J. Thompson memorial prize for his paper entitled, "Detection of television signals in thermal noise." The award is made annually to an author under 30 years of age at date of submission of manuscript for a paper recently published by the IRE that constitutes the best combination of technical contribution and presentation of the subject. Both awards will be presented during the IRE national convention to be held in New York, 19-22 Mar.

JEAN A. CURRAN, associate executive dean for medical education at the State University of New York, is on a 3-month leave of absence to conduct a survey of medical education in the Philippine Islands for the World Health Organization. His assignment calls for a study of the five Philippine medical schools and of other related health projects, such as nursing and student health. He plans to return to the United States via Formosa, Japan, Korea, and Hawaii.

EDMUND W. SINNOTT, Sterling professor of botany and dean of the graduate school at Yale University, gave the Hiram W. Thomas lecture at the University of Chicago on 9 Nov. He spoke on "Biology and religion."

CLIFF S. HAMILTON of the University of Nebraska has received the 1955 Midwest award in chemistry, an inscribed gold medallion that is conferred annually by the American Chemical Society's St. Louis Section.

The New York Academy of Medicine's 21st series of Lectures to the Laity is on the general theme, *Medicine and Anthropology*. The program for the series, which is supported by the Wenner-Gren Foundation for Anthropological Research, is as follows:

PAUL FEJOS, president, Wenner-Gren

Foundation for Anthropological Research, "Man, magic and medicine," 23 Nov.

MARSTON BATES, professor of zoology, University of Michigan, "The ecology of health," 7 Dec.

F. S. C. NORTHROP, Sterling professor of philosophy and law, Yale University, "Cultural mentalities and medical science," 4 Jan.

ALEXANDER H. LEIGHTON, professor of sociology, Cornell University, "Mental health and acculturation," 18 Jan.

RAYMOND W. FIRTH, head of department of anthropology, London School of Economics and Political Science, University of London, "Acculturation in relation to the concepts of health and disease," 1 Feb.

JOHN W. DODDS, director, special programs in humanities, Stanford University, "Whither mankind," 15 Feb.

JOSEPH C. BOYCE, associate director of Argonne National Laboratory, has become vice president of academic affairs and dean of the graduate school at Illinois Institute of Technology.

WALDEMAR OHLE, chemical limnologist of the hydrobiological laboratory at Holstein, Germany, is touring American universities to lecture on limnology. He recently visited Michigan State University under the sponsorship of the American Society of Limnology and Oceanography and the university's department of fisheries and wildlife.

JOSEPH HERRINGTON, assistant chief psychologist for the Leech Farm Veterans Administration Hospital, Pittsburgh, Pa., has been named associate professor of psychology at the University of Pittsburgh.

JOHN R. BARRY, for 4 years a psychologist for the USAF School of Aviation Medicine, Randolph Field, has also been appointed associate professor in the department of psychology.

LESTER HORWITZ of Midwest Research Institute, Kansas City, Mo., has received the 1954 Technical Paper award certificate from the Photographic Society of America for his article on "Mechanisms of color-sensitization."

JULIAN K. KNIPP, who for the past 7 years has been professor of physics at Iowa State College and senior physicist at the Ames Laboratory of the Atomic Energy Commission, has been named professor of physics and chairman of the Tufts University department of physics. An expert on high frequency electron tubes, his research activities include molecular, nuclear, and atomic studies, beta decay, energy-loss phenomena, and ionization statistics.

ROBERT C. BAY, veterinarian in charge of the colony of 450 beagles at the radiobiology laboratory of the College of Medicine, University of Utah, has received the first Schweitzer medal, which is to be presented each year by the Animal Welfare Institute to a scientist who makes an outstanding contribution to animal welfare.

W. EARLE DRENNEN, clinical professor of surgery at the University of Alabama since 1946, became professor emeritus on 1 Oct.

L. K. LEE, former head of the advanced techniques laboratory at Stanford Research Institute, and GEORGE H. GEICK of the Emerson Radio Company, have recently joined the mechanical division of General Mills, Inc., Minneapolis, Minn. Lee, a specialist in miniaturization and automatic production techniques for electronics, is technical adviser to the engineering research and development department. He is chiefly concerned with design for automation.

Geick is assistant manager of systems analysis. He was assistant to the executive vice president of Emerson and was concerned with the administration of commercial and military design and production in radio, television, and related fields.

Three German scientists also have recently joined General Mills' mechanical division. OTMAR M. STUETZER heads the electron physics laboratory. He was radar section chief of the German Research Council and coordinator of the German radar and countermeasures program during World War II. He joined General Mills from the U.S. Air Force's Wright Air Development Center at Dayton, Ohio, where he was chief of the advanced development branch in the electric components laboratory.

His staff includes GOTTFRIED K. WEHNER and LUDWIG J. MAYER, who worked with him at WADC. Wehner, a specialist in gas discharge and surface physics, was a branch chief at Flugfunkforschungs, the German Air Radio and Radar Research Institute, during World War II. Mayer was chief of the microwave tube laboratory at the same establishment.

Stuetzer did original work on metal lens antennas from 1936 to 1938, for which he won the Lilienthal award. His wartime research was concerned with microwave optics, propagation, and waveguide circuit elements. He was educated at the Technical University of Munich and taught electronics there for 7 years. Wehner and Mayer also did both their undergraduate and graduate work at the Technical University of Munich. Mayer developed the electron mirror surface microscope.

WALTER H. HODGE, assistant head of the Plant Introduction Section, USDA Plant Industry Station, Beltsville, Md., has been named superintendent of the new department of education at Longwood Gardens, Kennett Square, Pa., effective 1 Dec.

DONALD G. HUTTLESTON, formerly a taxonomist for the Brooklyn Botanic Garden, Brooklyn, N.Y., has been appointed taxonomist for Longwood. He will devote his efforts to the identification and labeling of the Longwood collections as well as to taxonomic research on ornamental plants.

FRANKLIN P. IAMS, assistant director of Rhode Island Hospital, Providence, R.I., will become administrator of University Hospital of New York University-Bellevue Medical Center on 1 Jan. 1956. Iams will fill the vacancy caused by the death on 27 June of Edward M. Bernecker.

PAUL L. MAGILL, chemical engineer and a senior scientist at Stanford Research Institute, Menlo Park, Calif., has been named United States technical representative to the new Central American Institute for the Investigation of Industrial Technology. To be located in Guatemala City, the research center is being jointly sponsored by the United Nations Technical Assistance Board and the governments of Guatemala, El Salvador, Nicaragua, Honduras, and Costa Rica. Magill will be on leave from S.R.I. for at least a year.

SAM C. SMITH, former associate professor of biochemistry at the University of Oklahoma School of Medicine, has joined the Research Corporation as secretary of the Williams-Waterman Fund. The corporation is a nonprofit foundation that makes grants for basic research in science.

The Williams-Waterman Fund is concerned primarily with the advancement of human nutrition and metabolism, particularly nutritional improvements in widely separated areas of the world. For example, during the past year the governments of the Philippines, Cuba, and Formosa initiated nutrition programs that were based on experiments and surveys which had been supported by the fund.

J. HAROLD BURN of the department of pharmacology, Oxford University, England, will hold this year's Abraham Flexner lectureship at Vanderbilt University. He will give a series of seven lectures during January and February on various aspects of pharmacology. A symposium on pharmacology is also planned during this period. Burn's lectures will be published in book form.

RICHARD M. SUTTON resigned on 31 Aug. as head of the department of physics at Haverford College to accept appointment as professor of physics at Case Institute of Technology. Sutton, who is on sabbatical leave from Haverford during 1955-56, is at present serving as Hill Family Foundation visiting professor at Gustavus Adolphus College, St. Peter, Minn., for the first semester.

SIDNEY W. FOX, formerly professor of chemistry at Iowa State College and professor in charge of the chemistry section of the Iowa Agricultural Experiment Station, has begun new duties as director of the Oceanographic Institute of Florida State University.

JOHN R. BUSICK has been named director of medical information at the University of Pennsylvania. Busick has been director of public relations at the Miami Valley Hospital, Dayton, Ohio, for the past 3 years. For 5 years previously he was director of public relations for George Washington University, Washington, D.C. His new duties will include public information and development work on behalf of the medical division of the University of Pennsylvania, the schools in this division, and its hospitals and institutes.

STUART O. FIEDLER has resumed the position of technical director of Bjorksten Research Laboratories, Inc., Madison, Wis. He previously served as vice president and technical director of the company from 1945 to 1947. Fiedler is also director of Kermetics Internacional, an association of consultants and development engineers who specialize in problems in rayon and synthetic fiber production and development in South American and Asian countries.

R. N. MARTIN, British geologist who has spent 4 years in Pakistan and Iran, is returning to Pakistan on a mission for the United Nations Educational, Scientific and Cultural Organization. He will teach petroleum geology at the University of the Punjab at Lahore, where a department of geology and mineralogy has been established with the aid of another UNESCO scientist, Olaf Anton Broch of Norway.

For the past 3 years, Martin has served as senior field geologist with the Attock Oil Company, Ltd., at Rawalpindi, West Pakistan. He was previously associated with the Geophysical Prospecting Company in London and with the Anglo-Iranian Oil Company.

WOLFGANG HUBER, chemical consultant, has recently moved his headquarters from Brooklyn, N.Y., to 68 Bret Harte Terrace, San Francisco, Calif.

MARY L. BUNTING, a lecturer and research worker in microbiology at Yale University, has been appointed dean of Douglass College at Rutgers University. Mrs. Bunting was married to Henry Bunting of the Yale School of Medicine, who died in 1954.

THOMAS H. MAREN, who at present is associated with the chemotherapy division of American Cyanamid Company, Stamford, Conn., has been appointed head of the department of pharmacology in the University of Florida's new College of Medicine. JOSHUA L. EDWARDS, assistant in the department of pathology and microbiology, Rockefeller Institute for Medical Research, New York, will be head of the department of pathology. Both appointments will be effective on 1 Dec. The College of Medicine will admit its first class in the fall of 1956.

HARALD SCHRAER of the Albert Einstein Medical Center, Philadelphia, Pa., will become director of the Bone Density Research and Evaluation Center at Pennsylvania State University on 1 Feb. 1956.

DIETRICH K. HAUSEN, former chief project engineer in multichannel microwave systems research for the U.S. Army in Europe, has been appointed director of electrical and electronic laboratories of the Commonwealth Engineering Company of Ohio, Dayton.

The President has approved the selection of nine scientists for advancement to the rank of captain, Medical Service Corps, Regular Navy: RICHARD H. LEE, physics, Panama City, Fla.; JOHN J. ENGLEFRIED, biochemistry, San Diego, Calif.; HERBERT S. HURLBURT, parasitology, Cairo, Egypt; LAVERNE A. BARNES, bacteriology, Honolulu, T.H.; JOHN D. DECOURSEY, entomology, Cairo, Egypt; HORACE C. DUDLEY, radiochemistry, St. Albans, N.Y.; ROLAND A. BOSEE, aviation physiology, Pt. Magu, Calif.; WILLIAM K. LAWLOS, entomology, San Diego, Calif.; VERNE W. LYON, experimental psychology, Pensacola, Fla.

The following appointments to assistant professor have been announced. University of Tennessee: ROBERT C. RENDTORFF, preventive medicine. Cornell University: DAVID D. CLARK, engineering physics. University of Pittsburgh, School of Medicine: ARVID EK, clinical science. University of Michigan: HAROLD L. SHEPPARD, sociology; WILBUR CHARLES BIGELOW, science (department of chemical and metallurgical engineering). Yale University, Forestry School: JACOB RIETSEMA, plant physiology. New York University Post-Graduate Medical School: PHILIP H. SECHZER, anesthesiology.

## Necrology

MARION MYER JACOBSEN, Albany, N.Y.; 51; clinical psychologist; former member of the faculty of Washington University Medical School in St. Louis, Mo.; 8 Nov.

HAROLD W. MERRITT, Wood Ridge, N.J.; 57; retired professor of physics at Cooper Union School of Engineering, New York, N.Y.; 8 Nov.

ARTHUR F. ST. ANDRE, Whippany, N.J.; 41; senior research chemist at Ciba Pharmaceutical Products; 24 Oct.

HORATIO B. WILLIAMS, Greenwich, Conn.; 78; physiologist; professor emeritus at Columbia University; 1 Nov.

## Education

■ A research center for fundamental studies of skin diseases is under construction at the Stanford University School of Medicine in San Francisco. Establishment of the Stanford Dermatology Research Laboratories will be financed by funds totalling \$115,000 from public and private sources. University property adjacent to the medical school is being remodeled for the purpose, and the laboratories should be ready for use in December.

Eugene M. Farber, head of the division of dermatology at Stanford, will direct the new research center, which will consist of laboratories for skin pathology, experimental mycology, and cutaneous physiology. The first of these three laboratories will be named the Herbert L. Harband Skin Pathology Laboratory in memory of a young Stanford graduate who died earlier this year. Members of his family have made available a fund of \$30,000 for construction and operation of the pathology facilities.

A grant of \$75,000 from the U.S. Public Health Service and \$10,000 in gifts from various private donors completed the \$115,000 fund needed to get the center started. This amount will cover costs of construction, equipment, staff, and research for at least 3 years.

■ George N. Shuster, president of Hunter College, and C. P. Rhoads, director of the Sloan-Kettering Institute, have jointly announced a new graduate program for the training of laboratory associates in the biological sciences. This program, which is to be initiated in February 1956, is designed to assist in alleviating the acute shortage in personnel qualified for positions in research laboratories and to serve the interests of individuals who desire further training in this area. It will be offered by the science faculties at Hunter College with the cooperation of some of the faculty of the

Sloan-Kettering Division of Cornell University Medical College at the Sloan-Kettering Institute.

A grant from the Alfred P. Sloan Foundation makes it possible to initiate this venture. This program is open to qualified college graduates who have majored in the sciences. Courses offered during the first semester will include an introduction to biophysical methods, mammalian physiology, microbiological and blood techniques, problems of microbiology, modern problems in zoology, and advanced blood chemistry. There will also be an opportunity for a practical internship.

Two graduate assistantships paying \$750 each are available to students who are prepared to study full time. Course fees are \$10 per credit. Individuals interested in the program may secure further information from the Office of Admissions of Hunter College, 695 Park Ave., New York 21, N.Y.

■ The University of Rochester has announced that tuition in the School of Medicine and Dentistry has been increased from \$800 to \$900.

■ The Institute for Cardiovascular Research of the Hahnemann Medical College and Hospital held open house ceremonies on 31 Oct. for preview display of its new research laboratories in the Mary Bailey Building, which is adjacent to the hospital.

■ The Institute of Statistics at North Carolina State College is sponsoring a 7-day intensive short course in "Statistical methods for research workers in industry and the physical sciences" 12-18 Feb. 1956. This program is designed to acquaint research workers in industry and the physical sciences with modern techniques of statistical analysis and experimental design.

Three lecture series will be given, one on elementary statistical analysis, one on regression analysis, and the third on experimental design. Guest lecturers will include W. G. Cochran, Johns Hopkins University; S. L. Crump, University of Rochester; and J. S. Hunter, American Cyanamid Company.

A registration fee of \$100 will be charged and enrollment will be limited to the first 50 applicants. For further information write to Institute of Statistics, North Carolina State College, Box 5457, Raleigh, N.C.

## Grants, Fellowships, and Awards

■ The National Science Foundation will extend its fellowship awards program during 1956 to include approximately 40 senior postdoctoral fellows in life and

physical sciences and closely allied fields. Under the broadened program fellowships will be awarded in mathematical, physical, medical, biological, engineering and other sciences, including anthropology, psychology (other than clinical), geography, and certain interdisciplinary fields.

To be eligible for the new awards, candidates must be citizens of the United States with demonstrated ability and special aptitude for advanced training and productive scholarship in the sciences. In addition, candidates must have at least 5 years experience beyond the science doctorate or its equivalent.

Fellows will be selected on the basis of ability as evidenced by letters of recommendation, academic records, and other evidence of attainment. Successful competitors will be announced in March 1956. Stipends of from \$4000 to \$10,000, adjusted to match as closely as is feasible the regular salaries of the award recipients, may be applied toward study or research in an accredited nonprofit institution of higher learning in the United States or abroad.

Applications may be obtained from the Division of Scientific Personnel and Education, National Science Foundation, Washington 25, D.C. Completed material must be received by 16 Jan. 1956.

■ The Educational Testing Service, Princeton, N.J., has announced that it is offering two fellowships in psychometrics for 1956-57. These are renewable research fellowships that provide for training in the Princeton offices of the Educational Testing Service in addition to a full-time program of graduate work for the Ph.D. degree at Princeton University in psychological measurement, mathematics, and allied fields.

Students in the program are offered a broad training in various fields of psychology, including experimental, social, and theoretical. Special training is also given in modern quantitative methods as applied to problems in learning and attitude measurement as well as in the techniques of developing aptitude and achievement tests.

Suitable undergraduate preparation may consist either of a major in psychology with supporting work in mathematics, or a major in mathematics with some work in psychology. However, in choosing fellows primary emphasis is given to superior scholastic attainments and demonstrated research ability rather than to specific course preparation.

To be considered for a fellowship in psychometrics, a candidate must either (i) have taken the Graduate Record Examinations in 1955; or (ii) register by 6 Jan. to take these examinations on 21 Jan. Fellowship applications are closed on 6 Jan. 1956.



■ The Lalor Foundation has announced details of the 1956 series of summer awards that it is granting for research in the biological sciences. There are to be 40 of these awards, an increase of 30 percent over 1955. They are designed to go to younger members of college and university faculties, with an age limit of 40 years.

The Lalor faculty summer research awards are for advanced research that employs chemistry or physics to attack problems in any field of biology. The studies may be carried on at any institution of the award holder's choice.

Stipends ordinarily will not exceed \$900 for a single man or woman, \$1100 for a married person working at his home institution, or \$1200 for a married person whose principal program is at another institution. Transportation costs and other expenses must be met by the candidate.

For the last several years the Lalor Foundation has supported a number of postdoctorate summer fellowships at the Marine Biological Laboratory at Woods Hole, Mass. Now, however, the M.B.L. fellowships are being consolidated into the enlarged program, and it is suggested that men and women interested in work at Woods Hole and eligible under the faculty summer award plan, should consider submitting applications under that newer plan.

Inquiries should be addressed: Director, Lalor Foundation, 4400 Lancaster Pike, Wilmington 5, Del. Final date for receipt of completed applications is 14 Jan. 1956, and notification regarding appointment may be expected by 15 Mar.

■ Continuing a program that began in 1951, the National Foundation for Infantile Paralysis will again offer fellowships during the calendar year 1956 for medical students interested in vacation-time study. The dean of each approved medical school in the United States has been asked to nominate six candidates for these awards: two for research in the biological and physical sciences related to medicine; two for public health and preventive medicine; and two for physical medicine and rehabilitation. Students must have completed 1 year in medical school to be eligible for the research fellowships and 2 years for each of the other types of awards.

Fellowships provide for full-time consecutive study during a period when the student has a minimum of 8 weeks of free time. The stipend paid will be \$200 a month for a minimum of 2 months and a maximum of 3 months.

During 1955, 77 schools participated in this program and 309 students received fellowships for vacation study. Since 1951, 824 medical student fellowships have been awarded.

Students interested in fellowships of this type should apply to the deans of their respective schools who will provide the necessary application forms. These must be submitted to the National Foundation for approval before the program begins. Six to 8 weeks should be allowed for administrative action by the National Foundation.

■ The National Science Foundation has announced 225 grants that amount to about \$3.46 million that were awarded during the quarter ending 30 Sept. for the support of basic research in the natural sciences, for conferences in support of science, and for exchange of scientific information. This is the first group of awards to be made during fiscal year 1956. Since the beginning of the program in 1951, more than 1875 such awards have been made, totaling about \$20.8 million.

#### Miscellaneous

■ The permanent office of the executive secretary of the American Nuclear Society has been established at the Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tenn. W. W. Grigorieff, recently elected executive secretary, succeeds William M. Breazeale of Pennsylvania State University, who has acted in an interim capacity since the founding of the society in January 1955. Grigorieff is chairman of the University Relations Division of ORINS.

The society's journal, *Nuclear Science and Engineering*, will be published by Academic Press, Inc., 125 E. 23 St., New York 10, N.Y., and will be devoted to papers describing original work in the fields of interest to the society. The first issue of the journal will be published in February 1956.

The new journal will be devoted to the experimental and theoretical study of atomic nuclei, not excluding those lines of research that may be expected to throw light on the nature of the nuclear forces—that is, on the one hand, the quantum theory of fields, and on the other hand, the investigation of the elementary particles. However, there is no rigid delimitation of the scope of the journal.

The emphasis will be laid on the publication of original papers, including extended reports of completed research as well as shorter notes announcing new results or presenting remarks and suggestions. An effort will be made to provide, whenever this may appear useful, longer review articles or shorter reports dealing with questions of topical interest. Moreover, as occasion arises, the journal will publish book reviews and news items of interest to nuclear physicists.

The international character of the journal is insured by the composition of the editorial board, which includes representatives from all countries or groups of countries in which nuclear studies are being pursued.

Contributions may be sent to the editor, Prof. L. Rosenfeld, Dept. of Theoretical Physics, The University, Manchester, England, either directly, or preferably through the intermediary of one of the members of the editorial board of the country or region in which the author is working.

■ The Intestinal Research Institute has been incorporated in New York State as a nonprofit educational, research foundation for the study of intestinal diseases. The incorporators are Earl J. Halligan, international secretary general of the International Academy of Proctology and director of surgery, Jersey City Medical Center; Alfred J. Cantor, editor of the *American Journal of Proctology*; Louis Wegryn, president of the International Academy of Proctology; and Paul Lahvis, chairman of the Foreign Chapters Committee of the academy.

An initial project on the possible virus etiology of ulcerative colitis is planned. Eminent virologists in the United States have been contacted, and a grant for this study will be established.

A research laboratory to study the etiology and pathogenesis of ulcerative colitis has also been established at 147-41 Sanford Ave., Flushing, N.Y., headquarters of the International Academy of Proctology.

Intestinal Research Institute funds will come primarily from contributions and grants. An initial grant of \$3000 has been provided by the International Academy of Proctology. All physicians are offered an opportunity to affiliate with the Intestinal Research Institute as contributing founders. For full details write to the Intestinal Research Institute, 147-41 Sanford Ave., Flushing, N.Y.

■ *To Enrich Mankind* is the title of a 25-minute color motion picture just prepared for the American Society of Mechanical Engineers. The film is designed "to explain to the public the significance of the role mechanical engineering plays in the development of our country."

A series of cuts shows how mechanical engineers contribute to the development of farm machinery, home appliances, aircraft, machine tools, rockets, atomic reactors, printing presses, and so forth.

Prints of the film are available on loan, without charge to schools, television stations and nonprofit organizations. Interested persons should write to Barbara A. Brown, Public Relations Dept., ASME, 29 West 39 St., New York 18.

## Reports and Letters

### Submerged Culture of *Micrococcus Lysodeikticus* for Large-Scale Production of Cells

Published methods for the production of large amounts of cells of *Micrococcus lysodeikticus* (1) for the isolation of bacterial catalase have consisted of surface culture techniques. For obvious reasons these methods are not very satisfactory or convenient. We have, therefore, explored the possibility of growing this organism as a submerged culture in a large volume of liquid medium (10 liters or more) and harvesting the cells by centrifugation with the Sharples centrifuge (2). Our initial efforts were unsuccessful until we discovered the requirement for a high pH by this organism. This report outlines the essential details of the culturing techniques we have adopted for growing and harvesting *M. lysodeikticus*. We expect to publish a more detailed report later.

The organism was obtained from the American type culture collection, No. 4698. The stock culture is maintained on agar slants at room temperature by transfers approximately once every 7 or 8 days. The viability of these organisms is remarkably stable at room temperature. The agar medium consists of the following: 1 percent yeast extract (Anheuser-Busch), 2 percent dextrose, 0.5M  $K_2HPO_4$  (8.7 grams per liter), and 1 percent of a salt solution containing the following: 4 percent  $MgSO_4 \cdot 7H_2O$ , 0.2 percent NaCl, 0.2 percent  $FeSO_4 \cdot 7H_2O$ , and 0.16 percent  $MnSO_4$ . The pH of the medium is brought up to approximately 8.0 with KOH (1 milliliter of 50-percent KOH per liter) before the 2-percent agar is added. The same medium is also used to grow the inoculum culture for the submerged cultures.

The liquid medium of the submerged cultures is made up from three solutions as follows. (i) Solution A: into a 12-liter flask are placed 9.1 liters of distilled water, 100 milliliters of the aforementioned solution, and 85 grams of  $NaHCO_3$  (final molarity in medium 0.1M). The surface of the liquid is sprayed with Dow Corning antifoam A spray. The flask is then autoclaved with a cotton plug for 1 hour at 15 pounds pressure. (ii) Solution B: into a 1-liter

flask are placed 100 grams of yeast extract and 400 milliliters of water. (iii) Solution C: into a 500-milliliter flask are placed 200 grams of glucose and 300 milliliters of water. The two cotton stoppered flasks are autoclaved for 20 minutes at 15 pounds pressure. After cooling, solutions B and C are added to solution A aseptically.

The inoculum is prepared either from surface cultures or from submerged cultures (with the afore-mentioned liquid medium) grown by the shake flask technique in 250-milliliter erlenmeyer flasks. We prefer the former method because it permits us to detect by visual inspection any possible contaminants in the inoculum. For growing the surface cultures, we have used Corning No. 4422 culture flasks that contain 1 liter of the agar medium. Approximately 48 hours after the agar medium has been inoculated, the cultures are harvested by washing the surface with sterile distilled water. If the cultures are not contaminated in this process, two successive harvests can be made from the same flask. The contents of two flasks are added to one submerged culture flask.

After inoculation, the liquid culture medium is vigorously aerated by sucking air through the liquid. The aeration system consists of an air exhaust and an air intake line which pass through a rubber stopper in the flask. The intake air is filtered through sterile cotton and dispersed in the medium by means of a sintered glass plug. The entire aeration apparatus is autoclaved separately. The cells are harvested from the liquid medium after 48 hours of growth at room temperature by means of the Sharples centrifuge.

The average yields of cells from the submerged cultures have been approximately 3.5 grams (dry weight) per liter of medium. A few experiments have been made with the shake flask technique and on one occasion the yield was 9 grams per liter. The total yield of the latter was small because of the limited number of flasks that could be handled conveniently. We have not yet attempted to determine the reason for the difference in yield by the two methods. However, the two most likely reasons are (i) larger initial inoculations by the shake-flask

method and (ii) better agitation of the bacteria in the shake flasks. It was pointed out to us that growth of aerobic organisms in large-scale liquid cultures is more vigorous if the cultures are simultaneously agitated and aerated (3). It is of interest to note that either the potassium or the sodium salt of bicarbonate may be used and that the molarity of the buffer can be as high as 0.2M without causing any detectable effect on the growth of the organism. However, 0.1M bicarbonate is adequate to keep the pH above 8.0 for 48 to 72 hours. The high pH is reached by the simple procedure of boiling off  $CO_2$  in the autoclaving procedure.

ROLAND F. BEERS, JR.

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Institute of Technology, Cambridge

#### References and Notes

1. D. Herbert and J. Pinsent, *Biochem. J. London* 43, 193 (1948).
2. I wish to acknowledge the technical assistance of Elizabeth Gaudy in this study. This investigation was supported by research grant C-2550 from the National Cancer Institute, National Institutes of Health, U.S. Public Health Service.
3. L. A. Underkoffler, private communication.

11 July 1955

### Plea for the Extension of Biological Abstractions

In any comparison of the biological and physical sciences one is struck by an apparent dearth of great theoreticians and radical turning points in the former, particularly within the present century. This is not to make the absurd assertion that the biological sciences have not had their great moments, but such moments have usually sprung from what immediately preceded. The progress has been amazing—but staid. There have been no grand explosions, one might almost say, since Pasteur and Darwin. The mathematical sciences understandably lend themselves to the purely speculative. However, there is more than such inherent difference. Those in the physical sciences, although undoubtedly awed by sheer magnitude, dare to ruminate upon the whole. That tremendous abstraction, life, is seldom considered in like manner except by philosophers and theologians, both of whom actually deal with man and his opinions of himself—endeavors generally conceded to be valuable although transcendental and unscientific. The biologist, deeply immersed in lymph, sap, or metabolites, seldom troubles himself with sweeping generalizations. It has been suggested that it is a vestige of the Middle Ages, a dear memento of the egocentric universe, a last refuge for man and his dignity. However, even ignoring the supposed scriptural ban does not appreciably facilitate



the impersonal approach to the meaning and ramifications of life.

In my opinion, an opinion for which a surprising amount of support has been found, the time has come to end this constriction of horizons. Shortly, it may well become imperative to end it. I have particular reference to extraterrestrial potentialities. Rocketeers have devoted untold hours of meditation and experimentation to their field, as have physicists, astronomers, and mathematicians. Although it is rather doubtful that astro-gation charts will be immediately available, their preparation would be largely a matter of erudite compilation. Biologically, that far horizon is populated only with present-day hippogriffs and afreets, the bug-eyed monsters of science fiction. A more reliable segment of the earth's population should be represented on that frontier. Medicine alone has pushed slightly beyond the boundaries of the commonplace with studies of the effects on life of such influences as increased gravity or acceleration and the obverse, weightlessness. This advance has been timorous. The penetration should be both broader and deeper.

Who is to say that man is the ultimate of ultimates? If he is not, why have we not suffered visitations? Perhaps we have. It would require little imagination to justify a *cordon sanitaire* against such barbarians as us. Such thinking must, for the time being, remain moot, merely idle speculation. More to the point might be a reexamination of the indispensability of the opposable thumb to the development of intelligence. Even more to the point might be a consideration of the necessity of free oxygen to the development of superior forms, particularly since one is faced with known anaerobiosis and the theoretical possibility of a more radical redox. Would earthly temperature ranges be mandatory for even the theoretical silicon-based biochemistry? Should not the pioneer of the perhaps not-too-distant future be prepared, to some degree, not only for the vicissitudes of different time and gravity factors and atmospheres of varying degrees of tenability, but also for the eventuality of alien life, intelligent or otherwise? Should he not be supplied with the conclusions of the educated conjecturer, information of value even if little more than a point of departure? Might not the Martian canal(?) lichen(?) proliferate dangerously if offered warmth, air, and moisture? Or would such abundance prove toxic? What agents might control it, or what might be its metabolic properties?

I suggest that a field of intellectual endeavor, which might be termed "theoretical biologics," is worthy of the most serious consideration. Far from being facetious, I feel that the depth of un-

derstanding and the scope of knowledge that are required for effective, intelligent work in this field would preclude even the consideration of it by all but candidates for the doctorate and beyond. Unfortunately, many a recognized and respected Ph.D., by the very nature of his extreme specialization, could not boast of sufficient breadth. Perhaps no man ever could. Perhaps only cooperation and teamwork could effect any reasonable synthesis of ideas.

With the advent of the orbital unmanned satellite, perhaps some action will be taken on behalf of those who will form the crews in the next logical development. Certainly it would be stupid, criminally stupid, as well as wasteful of human life and treasure, to send men into space elegantly equipped with every device conceived by the physical scientists only to lose the entire expedition through the action of some biological agency that might have been anticipated. In the physical realm, as in the biological, eventualities beyond imagination might arise. Such could be borne with resolution. Within the scope of the imaginable, no matter how improbable, there can never be any excuse for the lack of foresight and preparation. To precisely such preparation, both experimentally and abstractly, the biologist might well direct his efforts, for, to borrow an expression, "It's later than you think."

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13 June 1955

### Dietary Casein Level and B-Factor Deficiencies Produced by Antagonists

The influence of dietary protein and carbohydrate levels on B-factor requirements has been given considerable attention. Among other things, it has been thought (1, 2) that the requirements are related to the need for B-factors in various enzyme systems in which it could be shown that they play an important part. In most previous studies, however, the presence of tissue stores of B-factors and their production by the intestinal flora interfered with the experiments. It therefore seemed desirable to re-examine some of the problems with the help of reliable antivitamins, which are now available.

Weanling albino rats from a uniform colony were distributed into matching groups of eight to 16 animals. They were fed highly purified diets that contained dextrose and casein in varying ratios and 10 percent lard, together with cellulose, salts, and liberal amounts of all vitamins

(3). The casein had been made virtually vitamin-free by a special method of purification. All procedures have been previously described in detail (2).

When thiamine-free diets containing 5, 30, or 84 percent casein along with 79, 54, or 0 percent dextrose were used, the rats that received the lowest level of protein died earlier than those that received the higher ones; this is in agreement with the observations that replacement of carbohydrate by protein (3) or fats (4) has a thiamine-sparing effect. It is usually believed (5) that this is the result of the fact that thiamine is chiefly involved in the enzyme systems necessary for the metabolism of carbohydrate rather than the systems necessary for the metabolism of protein and fat.

However, when rats were placed on the same diets and injected daily with 50 micrograms of pyriethiamine (the most potent thiamine antagonist, 6) they died, on the average, much earlier than those that had not received the antithiamine. Moreover, in contrast to the uninjected groups, those on the lowest protein intake survived significantly longer than those on the higher levels (Fig. 1). These experiments were made twice (with groups of eight and 16 rats), and both times the differences observed were found to be statistically significant.

On the basis of this experiment, it can be concluded that the thiamine requirements of rats increase with increasing dietary protein levels if the rigid exclusion of thiamine from the diet is associated with the use of pyriethiamine, which denies the animals the use of both thiamine stores and that produced by the intestinal flora. If these requirements have any relationship to the role of thiamine in enzyme systems and if pyriethiamine exerts no effect other than that of a thiamine antagonist, one must conclude that thiamine plays an important part not only in carbohydrate metabolism but also in protein metabolism.

It has been demonstrated (2) that the riboflavin requirements of rats fed the potent riboflavin antagonist, galactoflavin, and maintained on riboflavin-deficient diets increase with increasing dietary protein levels. This could be concluded from observations on survival rates, body weights, and food consumptions. This and other considerations strongly indicated that protein and riboflavin are mutually limiting factors in metabolism.

Increased pyridoxine requirements with increasing dietary protein levels have been found even when no antagonist was administered (7). In our experiments, the animals were fed pyridoxine-deficient diets containing 5, 30, or 74 percent casein and were given daily oral feedings of the pyridoxine antagonist, desoxyxyri-

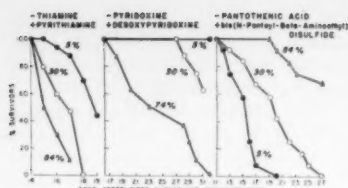


Fig. 1. Survival rate of B-factor-deficient rats on purified diets with varying casein levels and supplied with the appropriate antivitamins.

doxine; observations were made of growth, food intake, development of the "acute deficiency" state (8), and survival time. In all these aspects, the animals on 74-percent casein showed the most severe changes; those receiving 5 percent showed scarcely any and the ones fed 30 percent were in between. Death, in particular, occurred earliest with 74-percent casein and not at all during the time of observation among those on 5-percent casein (Fig. 1). Thus, the use of an antagonist does not alter, but strongly intensifies, the differences in pyridoxine requirements, which go parallel to the casein content of the diet. The rapid occurrence of a severe deficiency state at high dietary protein levels is indicative of the great importance of pyridoxine in the protein-metabolizing enzyme systems. As in the case of riboflavin and thiamine, pyridoxine and protein are mutually limiting factors.

It has been found that the signs of pantothenic acid deficiency become less pronounced if the carbohydrate in the diet is partly replaced by protein (9); no antagonists were used in those experiments. In our experiments, groups of 12 rats received 5-, 30-, and 84-percent casein in pantothenic acid-deficient diets and daily injections of 10 milligrams of the pantothenic acid antagonist, bis-(N-pantoyl-beta-aminoethyl)disulfide (10). In Fig. 1 it is demonstrated that the survival rate of these animals increased very significantly when carbohydrate in the diet was replaced by protein. Although the casein had been specially purified, these experiments (just as previous ones) did not entirely rule out the possibility that the milder form of the deficiency state was the result of the presence of traces of pantothenic acid in the casein. This argument could be entirely refuted by an experiment in which eight animals that received 30-percent casein were restricted in their food intake so that they just maintained their body weights. This group survived the freely eating, slowly growing, deficient animals on the same diet. Therefore, the longer life span of animals on the high casein level is not the result of traces of pantothenic acid

in the casein because the animals on the restricted food intake that survived their controls received less casein. The experiment further demonstrates that the signs of the deficiency state are less pronounced if the food intake is restricted.

Despite the rigid exclusion of pantothenic acid from the diet and the use of a potent antagonist, increased dietary protein levels decrease the pantothenate requirements; thus, pantothenic acid and protein are probably not mutually limiting factors. Inasmuch as, in these experiments, high dietary protein levels mean low carbohydrate levels and vice versa, these experiments indicate that such mutual limitation exists between carbohydrate and pantothenate.

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#### References and Notes

1. H. M. Evans and S. Lepkovsky, *Science* **68**, 298 (1928); *J. Biol. Chem.* **83**, 269 (1929).
2. H. Kaunitz et al., *J. Nutrition* **52**, 467 (1954).
3. Leo A. Pirk of Hoffman-La Roche, Inc., Nutley, N.J., generously supplied us with most of the vitamins used.
4. W. J. Dann, *Federation Proc.* **4**, 153 (1945).
5. B. C. P. Jansen, in *The Vitamins*, W. H. Sebrell, Jr., and R. S. Harris, Eds. (Academic Press, New York, 1954), vol. 3, p. 472.
6. D. W. Woolley, *A Study of Antimetabolites* (Wiley, New York, 1952).
7. L. R. Cerecedo and J. R. Foy, *Arch. Biochem.* **5**, 207 (1944).
8. H. C. Stoerk, *Ann. N.Y. Acad. Sci.* **52**, 1302 (1950).
9. M. M. Nelson and H. M. Evans, *Proc. Soc. Exptl. Biol. Med.* **60**, 319 (1945); **66**, 299 (1947).
10. We are very grateful to Merck and Company, Rahway, N.J., for supplying us with galactoflavin, desoxyxypyridoxine, and the pantothenic acid antagonist. The properties of the latter have been discussed by G. E. Boxer, C. E. Shonk, H. C. Stoerk, *Federation Proc.* **14**, 185 (1955).

12 July 1955

#### Regeneration of X-rayed Salamander Limbs Provided with Normal Epidermis

It has been suggested that a large part of the regenerate of a salamander limb arises from epidermal cells (1, 2). The evidence for this is that, as the blastema forms, approximately the same number of mesenchymal regeneration cells appear as there are epidermal cells disappearing. It is believed that the epidermal cells change into mesenchymal cells *in situ* in the epidermal cap. This transformation had been described earlier (3) but had not been interpreted as evidence for a permanent change. Other investigators, while confirming the loss of many epidermal cells during blastema formation (4, 5), believe that these cells die, but this has not been studied quantitatively.

Still others, for various indirect reasons, believe that a transformation from differentiated epidermis to a variety of internal limb tissues is unlikely (6-10). Direct evidence that epidermal cells can transform to mesenchymal cells was obtained by tracing polyploid epidermis on a diploid limb stump and later recovering it as mesenchymal tissue (11). There is still a question whether the marked mesenchymal cells that had been epidermal could have completed the transformation to differentiated mesodermal tissue.

Because of general interest in the extent of cellular transformation during regeneration and because there have been different interpretations of data already presented, a more rigorous test of the possibility of epidermal transformation has been made.

The best method for testing the potency of a tissue during limb regeneration is the method of transplanting it to an x-rayed limb that is incapable of growth or regeneration. Sufficient x-irradiation completely prevents growth and regeneration. The change appears to be permanent and irreversible (12). If normal tissue is transplanted to an x-rayed limb and the limb is subsequently amputated at the level of the graft, whatever regenerates must arise from the grafted tissue. The method has been used previously to demonstrate that bones, muscles, and whole skin can each produce whole limbs (13, 14). In the present work (15), an attempt has been made to learn whether the epidermis alone can furnish the cells for limb regeneration.

Both forelimbs of 55 adult *Triturus viridescens* were x-rayed below the elbow with single dosages of 500 to 10,000 roentgens. The conditions of irradiation were 150 kv and 8 ma with a delivery rate of 745 r per minute at a distance of 11.5 cm. The upper arms and the rest of the animal were protected by lead shields. Left forelimbs served as controls. These were irradiated and either 7 or 28 days later were amputated midway between wrist and elbow. Right forelimbs were treated in the same way except that, in addition, whole skin was stripped off the stump up to the unirradiated tissue 1 mm above the elbow at the time of amputation. It was known from work with polyploid skin transplants that only the epidermis migrates and piles up at the tip of the stump (11). Hence, in the right limbs, the epidermis that migrates to cover the stumps was unirradiated.

On all 55 animals the limbs that became covered with unirradiated epidermis regenerated. No complete hands regenerated from the control stumps. After the 3 lowest x-ray dosages, 500, 1000, and 2000 r, there was some outgrowth

from the irradiated control stumps, but these outgrowths in all cases were simple cartilaginous spikes covered by skin. After a dosage of 3500 r or more, there was complete absence of regeneration on the control side, but all x-rayed limbs that were provided with unirradiated epidermis showed some hand regeneration. This included the experimental limbs in the groups that received 3500, 5000, 7500, or 10,000 r. There were at least 5 useful cases in each radiation group except in the group that received 10,000 r. All but one animal in the 10,000-r group died before regeneration had been completed. The type and amount of regeneration is shown for 4 representative cases in Fig. 1.

Appreciable growth potential remained in the 500-r series when all tissues were irradiated. When unirradiated epidermis has been added, the form of the regenerate is better and the amount of regeneration is greater. With dosages from 3500 to 10,000 r there was no outgrowth after both internal tissues and epidermis had been irradiated. However, there was some regeneration even from atrophied stumps whose internal tissues had received higher dosages, provided that they had been covered with unirradiated epidermis. Diminishing size of regenerate with increasing dosage may be accounted for in large part by the decreasing growth potential of the internal tissues. At 3500 r and above there was

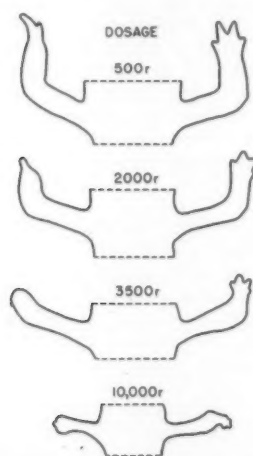


Fig. 1. Representative regenerates showing extent and type of regeneration after various x-ray dosages. The limbs were irradiated below the elbow. All limbs were amputated half way between the wrist and elbow. Left, regeneration after simple amputation through forearm; right, regeneration after amputation and removal of skin to a point above the elbow. The limbs on the right received unirradiated epidermis. The diagrams are drawings from photographs of the same magnification.

no outgrowth from controls and the stumps became smaller. From this dosage upward, any regeneration that occurred in the right limb must have resulted from the unirradiated epidermis.

Some of the decrease in size of regenerates may result from increasingly deleterious effects of the x-rayed stumps upon the regenerates. This was quite apparent in the 10,000-r series, where failure of the epidermis to maintain a complete cover around and over the stump was observed. In spite of this there was regeneration of a recognizable hand on the one 10,000-r animal that lived.

The possibility that the unirradiated epidermis reactivated the internal tissues has been considered seriously (16), but all evidence is against it. As shown by Brunst (12), x-rayed limbs remain for years incapable of regeneration. There is additional counterevidence in the present work. The stumps of all x-rayed limbs lost some volume. The presence of an unirradiated epidermis does not reactivate to protect against this loss. In all cases the shrinkage of the stump was the same whether irradiated or unirradiated epidermis was present. This is evidence against reactivation.

Direct evidence that only the unirradiated tissue participates in regeneration was obtained by Umanski (47). After a dosage of 5000 r to hind limbs of black axolotls whose internal tissues are dark, followed by transplantation of forelimb skin from white axolotls and subsequent amputation, completely white forelimbs regenerated on the stumps of the hind limbs. Umanski suspected that the dermis was the source of the regeneration cells, but the hypothesis was not tested.

It is concluded that epidermis can serve as the only source of cells for a regenerating limb. It now appears likely that any limb tissue can serve as a source of regeneration cells. Whether one is the predominant source both in larvae and adults is not clear. Better regenerates were obtained from x-rayed stumps when normal whole skin was transplanted than when either muscle or bone was used (18).

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#### References and Notes

1. E. Godlewski, *Wilhelm Roux' Arch. Entwickl.-lungs-mech. Organ.* 114, 108 (1928).
2. S. M. Rose, *J. Exptl. Zool.* 108, 337 (1948).
3. A. Ide-Rozas, *Wilhelm Roux' Arch. Entwickl.-lungs-mech. Organ.* 135, 352 (1936).
4. D. T. Chalkley, *J. Morphol.* 94, 21 (1954).
5. H. W. Manner, *J. Exptl. Zool.* 122, 229 (1953).
6. E. G. Butler and O. E. Schotté, *ibid.* 112, 361 (1949).
7. P. Weiss, *Quart. Rev. Biol.* 25, 177 (1950).
8. H. D. Heath, *J. Exptl. Zool.* 122, 339 (1953).
9. A. G. Karczmar and G. G. Berg, *ibid.* 117, 139 (1951).

10. J. S. Nicholas, in *Analysis of Development* (Saunders, Philadelphia and London, 1955) sect. 13, chap. 2.
11. E. D. Hay, *Am. J. Anat.* 91, 447 (1952).
12. V. V. Brunst and E. A. Cherenetieva, *Arch. zool. exptl. et gen.* 78, 57 (1936); V. V. Brunst, *Quart. Rev. Biol.* 25, 1 (1950).
13. E. Umanski, *Biol. Zhur.* 6, 737 (1937).
14. C. S. Thornton, *J. Exptl. Zool.* 89, 375 (1942).
15. This study was in part supported by the National Science Foundation grant G 113.
16. F. C. Rose, H. Quastler, S. M. Rose, *Anat. Record* 117, 619 (1953).
17. E. Umanski, *Bull. biol. med. Exptl. U.R.S.S.* 6, 141 (1938).
18. H. A. L. Trampush, *Koninkl. Ned. Akad. Wetenschap. Proc. 54C*, 373 (1951).
- 11 July 1955

#### Action of Pectic Enzymes on Surface Cells of Living Brassica Roots

Robert's conclusion (1) that the root-hair wall consists of an inner layer of cellulose and an outer layer of calcium pectate continuous with corresponding layers in the hair-forming cell has been confirmed and denied (2). I obtained strong confirmatory evidence (3) from microchemical tests and by growing roots of *Brassica* seedlings in a variety of cultural solutions that were designed either to prevent or to stimulate calcification of the pectic layer. In this connection, the experiments with ammonium oxalate solutions were particularly convincing (3). A theory of root-hair development was formulated, that was based on the gradual hardening of the outer pectic layer to calcium pectate (2-4).

More recently, Ekdahl (5) considers the pectic and cellulosic substances to be uniformly distributed in the hair-wall and not separated into two distinct layers. In his opinion, calcification does not occur and hardening is due entirely to changes in the cellulosic substances.

Ekdahl's view still lacks direct proof and does not explain the fact that anything which prevents calcification also prevents root-hair formation. Furthermore, in denying the existence of an outer pectic layer or so-called middle lamella substance, his view fails to explain many well-known cellular phenomena such as the normal sloughing of root-cap cells, the formation of intercellular spaces, and the maceration of multicellular tissues by pathological organisms and chemical reagents.

The recent use of pectic enzymes in the maceration of plant material (6) suggested that they might be useful in the present problem. If an outer cementing layer of pectic material occurs in the epidermal cell walls, then it should dissolve on treatment of the root with pectic enzymes. To test the validity of this assumption, *Brassica* seedlings (*Brassica napus* var. *oleifera*), were grown in several different preparations of pectic enzymes



under the trade name Pectinol (7) in different concentrations and at different temperatures. Only one, namely, Pectinol 100 D, was found to be effective. *Brassica* roots were used because it was known that they produce abundant hairs in tap water (2, 8).

Following germination, when they had attained a length of 1 to 3 millimeters, the roots of ten seedlings were placed through small holes in pieces of stiff, paraffin-coated paper and floated in tap water in small beakers, at 30°C. At the end of 6 hours, the floats were transferred to a filtered solution of Pectinol 100 D.

Great difficulty was experienced in keeping the roots alive. However, by dusting the seeds with Orthocid prior to germination and by means of the

method described previously (3), it was found possible to grow roots in a 0.75-percent flowing solution of Pectinol 100 D in distilled water at 30°C. At the end of about 16 hours, only about half of the roots showed signs of growth. These roots measured 5 to 15 millimeters, about half the length of control roots in tap water. All treated roots had an unusual appearance characterized by the lack of hairs, discoloration, plasmolysis, separation of epidermal cells, and abnormal sloughing of root-cap tissue. Some epidermal cells were free at one or both ends (Fig. 1 A), others were twisted out of position, and still others had dropped from the root, leaving empty gaps in the epidermis. The walls of the separated cells were thin but distinct and gave a positive test for cellulose. The deformities were such that they could be explained on the basis of enzyme action on the outer, cementing pectic layer, leaving the cellulose layer intact.

As in the earlier experiments with ammonium oxalate solutions (3), transfer of Pectinol-100-D-treated roots to a saturated solution of calcium sulfate resulted in resumption of normal growth, with the cessation of abnormalities and the immediate production of long hairs. That part of the root developed in the Pectinol 100 D solution remained unchanged. Some roots failed to respond, indicating irreparable injury to the apical meristem.

The condition of the root cap was of particular interest. In control roots, it formed a distinct, uniform covering over the root apex, the sloughed cells possessing healthy protoplasts and firm definite walls (Fig. 1B). In sharp contrast, the root caps of Pectinol-100-D-treated roots presented a discolored mass of partially or wholly macerated cells. In some cells the wall was thin, but distinct and definitely of cellulose, in others it was barely visible, and in still others it was dissolved completely (Fig. 1C).

The results of the experiments with pectic enzymes confirm earlier observations (1-3) of the occurrence of an outer layer of pectic material in the walls of the epidermal cells. If there were no definite cementing layer, it is inconceivable how individual cells could separate. The observations of recovered roots after removal to a calcium solution also corroborate the further view (2-4, 8) that hardening is the result of incorporation of calcium into the outer pectic layer of the elongating cell walls.

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#### References and Notes

1. E. A. Roberts, *Botan. Gaz.* 62, 488 (1916).
2. R. G. H. Cormack, *Botan. Rev.* 15, 583 (1949).
3. ———, *New Phytologist* 34, 30 (1935).
4. ———, *Science* 119, 615 (1954).

5. I. Ekdahl, *Symbolae Botan. Upsalienes* 11, 5 (1933).
6. N. W. Stuart and S. L. Emsweller, *Science* 96, 569 (1943); H. H. McKay, *Stain Technol.* 21, 111 (1946); L. A. Hohl, *ibid.* 23, 129 (1948); D. S. Van Fleet, *Botan. Rev.* 18, 354 (1952).
7. I wish to thank M. D. Labbee of Rohm and Haas Co. for generous samples of Pectinol preparations and for his kindly interest.
8. C. H. Farr, *Quart. Rev. Biol.* 3, 343 (1928).

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## Response of the Slime Mold to Electric Stimulus

There are four fundamental properties of protoplasm of peculiar interest to the student of the nervous system. These are (i) that a change in the physical or chemical environment of protoplasm brings about an alteration in the phase boundary of the protoplasm that can be identified by (ii) the change that is propagated through its substance, usually with direction, (iii) that protoplasm possesses the property of integrating, coordinating, or correlating all the events that occur at the phase boundary, and (iv) that protoplasm reacts in a characteristic manner to this chain of events.

Although something is known about these four properties, the exact mechanisms involved have not yet been unraveled. However, students of the nervous system have presented a great deal of evidence concerning the nature of the physical and chemical changes in the environment necessary to stimulate a neurone. In addition, a good deal of information is available concerning the propagation of the stimulus through protoplasm. In this last case, the advent of electrometric techniques has made it possible to define, with considerable accuracy, quantitatively and qualitatively, the electric aspects of the propagated impulse.

Since the great complexity of the nervous system in vertebrates and also in invertebrates makes analysis of the mechanisms involved exceedingly difficult, an attempt has been made to approach this problem in a very much simpler but still very complex living organism, the slime mold, *Physarum polycephalum* (1). Tasaki and Kamiya (2) have reported that the slime mold will respond to a tap stimulus and to an electric stimulus in much the same manner. Using a very high input impedance direct-current amplifier coupled through a counter electromotive force to the direct-current amplifier of a Dumont 304H oscilloscope, similar responses were obtained by us with some very striking differences.

Figure 1 is a photograph of the oscilloscope trace following a tap stimulus. This response is a graded response. A weak stimulus is sufficient to start it; it



Fig. 1. A, epidermal cells of a root grown in a 0.75-percent flowing solution of Pectinol 100 D ( $\times 135$ ). Separation of the cells indicates a change in the pectic layer. B, normal root-cap cells ( $\times 660$ ). C, root-cap cells from the same treated root shown in A, showing complete dissolution of the cell walls ( $\times 660$ ).





Fig. 1. Oscilloscope trace of response to tap stimulus.

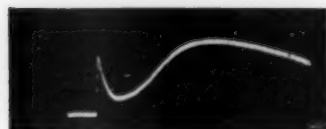


Fig. 2. Oscilloscope trace of response to electric stimulus.

disappears on repetition and when the plasmodium is killed. In addition, there is apparently an upper limit as the intensity of the blow is increased. The magnitude of the response may reach as high as 75 millivolts. There is good but not conclusive evidence that the magnitude of the response to a given strength of stimulus is significantly related to the vigor of the plasmodium. It can be demonstrated that this stimulus response is propagated along the thread.

In order to obtain a full picture of this response, the sweep speed of the oscilloscope was reduced to 2 seconds per inch by connecting a high capacitance across the sawtooth terminal and ground. Since the parameters of this response can be defined with considerable accuracy, it would seem that such a preparation makes an ideal test specimen for the assay of the effect of a variety of chemical agents on the activities of the protoplasm.

The attempt to stimulate the plasmodium electrically is fraught with many difficulties. The physical state of the environment of the plasmodium, which is determined in part by the electrolyte solution, the dimensions and placements of the electrodes, and the resistance and distributed capacity of the whole system in the absence of the plasmodium, produces pictures that are similar to a biological response. However, an electric response can be obtained, as is evidenced by Figure 2. Taken under the same conditions of calibration as the tap stimulus, the response shows qualitatively the same characteristics. Again the magnitude of the response would seem to be in some measure related to the vitality of the protoplasm, since a vigorous thread of rapidly streaming protoplasm gives a higher response than a thin thread with somewhat sluggish flow. Very rarely is the magnitude of the response anything like that following a tap stimulus.

The conditions necessary to produce an

electric response to an electric stimulus seem quite different from those reported by Tasaki and Kamiya (2). The technique used in this study showed no evidence of a millisecond response, no matter what the voltage or current employed. Instead, it was found that a stimulus of at least 0.1-second duration seemed to be required. With such a duration, a response was obtained with a stimulus of 800 microamperes at 1.5 volts. Increasing the strength of the stimulus to 1 milliampere at 4.5 volts produced a graded response. Occasionally, this could be carried into higher levels. However, if the electric stimulus was increased very much, either the response failed completely, possibly because of a shock effect, or else it was obscured by the stimulus artifact.

The difficulty in getting a consistent response from the familiar electric set-up is the result of the simple fact that the protoplasmic thread is not a nerve fiber. A slime mold is capable of transmitting a stimulus just as is all living matter, but it differs from other tissues. For example, an excellent action potential of *Dionaea* was obtained by Stuhlman and Darden (3) with a maximum of 130 millivolts.

Tauc (4) attempted to find an action potential in *Physarum* but obtained only a spontaneous drop in the resting potential that was possibly owing to the formation of a membrane over the electrode.

The plasmodium of a slime mold is in reality "tissue" in the sense that it is an aggregation of centers of activity that are "cells" without walls. In short, it is not a homogeneous mass even though it is a continuous sheet of flowing protoplasm. Moreover, it moves—toward food, for example—as an integral whole and must therefore possess some means for transmitting stimuli from one point to another (5).

We may conclude, then, that a strand of one of the most primitive forms of life yields an action potential, both when it is stimulated electrically and when it is stimulated mechanically.

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#### References and Notes

1. This work was aided by a grant from the Fluid Research Funds, Yale University School of Medicine.
2. I. Tasaki and N. Kamiya, *Protoplasma* 39, 333 (1950).
3. O. Stuhlman and E. B. Darden, *Science* 111, 491 (1950).
4. L. Tauc, *J. physiol. Paris* 45, 232 (1953).
5. W. Seifriz, *Nature* 171, 1136 (1953).

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#### Regional Crossbedding and Petrology as Source Area Indicators

Basal Pennsylvanian sediments (Caseyville, Mansfield, Babylon sandstones, and equivalents) of the Eastern Interior Basin (Fig. 1) are separated by 500 to 1200 miles from possible source areas such as the Canadian shield and inferred Paleozoic uplands to the east. This geographic separation, together with mineralogic maturity and lithologic uniformity of the sandstones, makes it difficult if not impossible to determine source areas from regional variation of gross lithology. This is especially true because appreciable extrapolation beyond present basin limits is required. Our solution to this problem involves regional measurement of crossbedding and regional sedimentary petrology to determine the location and composition of probable source areas.

In order to have fullest confidence in our conclusions, it was necessary to study basal Pennsylvanian sandstones of the Michigan Basin (Parma sandstone) and portions of the Appalachian Basin (Sharon and Lee sandstones) in addition to the sandstones of the Eastern Interior Basin. Inclusion of these areas led to more definitive conclusions about Eastern Interior Basin sediment sources and provided the essential key to a sediment source interpretation of the basal Pennsylvanian of much of the northeastern part of the United States.

More than 950 measurements of crossbedding in 340 outcrops were obtained from more than 1000 miles of linear basal Pennsylvanian outcrop in the North Central States. Statistical analysis (hierarchical case of the analysis of variance) provided measures of reliability for average directions of sediment transport and also segregated total variability of crossbedding direction into small scale (within an outcrop), intermediate scale (within a 6- or 12-mile interval), and large scale (between 6- or 12-mile intervals along the outcrop belt). The order of variability within an outcrop is much less than it is within an interval and within an interval it is greater than it is between intervals along the outcrop belt.

Regionally, crossbedding direction is very uniform. Crossbedding points south-southwest in all areas studied except in western Illinois, where it points south-east. The crossbedding is interpreted as accurately reflecting sediment transport on the regional slope from the source area toward the area of greatest subsidence and crustal instability (Ouachita trough). Excluding western Illinois, a general southwestward tilt of the craton in the North Central States is implied.

Because of the orthoquartzitic char-

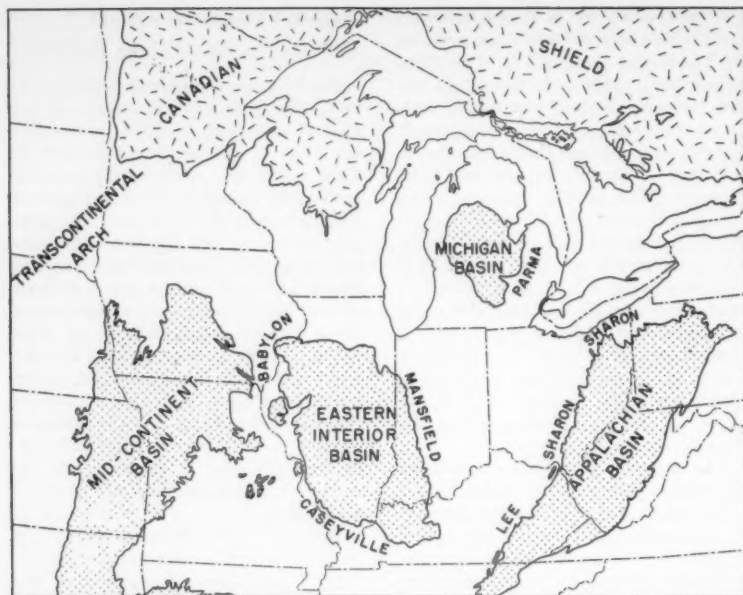


Fig. 1. Index map showing general structural framework of area and basal Pennsylvanian formations studied.

acter of these sands, relative abundance of the quartz varieties and tourmaline roundness provided the best basis for determination of regional mineral associations. Measurements of these two parameters, together with modal mineralogy, analyses, were obtained from 79 samples. Statistical analysis (the analysis of dispersion, a form of multivariate analysis) was used to test for significant differences between mineral associations. In western Illinois, where crossbedding indicates a southeastward transport direction, feldspar is very low (less than 1 percent), metamorphic quartz varieties are low, and tourmaline roundness is high. The high roundness of these sands implies a long history of abrasion. Their mature mineralogy indicates a similar conclusion.

Hence, the basal Pennsylvanian sands of western Illinois were derived from preexisting sediments with a long transport history. In contrast, the basal Pennsylvanian sediments of other parts of the North Central States, which all have a general south-southwestward flow pat-

tern, have somewhat more feldspar (1 to 5 percent), more metamorphic quartz, and low tourmaline roundness; they are also characterized by metamorphic quartz pebble conglomerates. This implies a source area dominantly composed of preexisting sediments only one or two cycles removed from their parent crystalline rocks. In each case, contrasts in transport direction coincide with detrital mineralogic contrasts.

Based on this crossbedding and petrologic evidence, most of the northeastern part of the United States, including the Michigan Basin, the northwestern portions of the Appalachian Basin, and most of the Eastern Interior Basin, had a common source in the northeastern United States and/or in the southeasternmost parts of the Canadian shield. The western Illinois part of the Eastern Interior Basin, farther in the interior of the continent, had a minor source to the northwest, the Transcontinental arch.

This study (1) shows the value of field mapping of appropriate directional sedimentary structures (in this case, cross-

bedding; in other cases, flow marks, slump structures, and so forth) as a rapid and easy method of assessing source area location. Sedimentary petrology leading to knowledge of regional mineral associations not only permits inferences concerning composition but, further, provides a valuable internal check on the degree to which the directional sedimentary structures truly reflect the regional slope. Knowledge of regional mineral associations is especially necessary in clean marine shelf sandstones where relationships of sediment transport direction to the regional slope are not completely understood.

Basal Pennsylvanian sediments, a relatively thin stratigraphic interval, show a very widespread areal uniformity in sediment transport direction. Over smaller areas, it has been shown that similar uniformity of transport direction exists through many hundreds of feet of both shallow shelf and geosynclinal deposition (2-4, and others). Thus, it appears that in many cases of both cratonic and geosynclinal sedimentation, large sedimentary volumes have had relatively uniform transport directions. Such uniformity appears to be especially characteristic of stable shelves and geosynclines in the preorogenic stages of development. Distribution of structural elements and magnitude of differential activity between them control this uniformity.

The combined knowledge of directional sedimentary structures and petrology thus provide on a regional scale a sensitive and rapid assessment of the ultimate objectives of a provenance study—regional tectonics and paleogeology. Additional provenance studies using the methods employed here will probably be the most accurate and rapid way available for reconstruction of the structural development of the continents.

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#### References and Notes

1. This article is published with the permission of the chief, Illinois Geological Survey. A complete report of this investigation will be published in *J. Geol.*
2. G. H. Brett, *J. Geol.*, in press.
3. F. P. H. W. Kopstein, *Pub. Geol. Inst. Gröningen No. 81* (1954).
4. G. Wilson, I. Watson, J. Sutton, *Geol. Mag.* 90, 377 (1953).

14 July 1955

*Necessity is not the mother of invention; knowledge and experiment are its parents. This is clearly seen in the case of many industrial discoveries; high-speed cutting tools were not a necessity which preceded, but an application which followed, the discovery of the properties of tungsten chromium-iron alloys; so, too, the use of titanium in arc lamps and of vanadium in steel were sequels to the industrial preparation of these metals, and not discoveries made by sheer force of necessity.*—W. R. WHITNEY.

## Book Reviews

**The Liver and Cancer.** A new cancer theory. Kaspar Blond. Wright, Bristol, England, 1955. (distrib. by Williams & Wilkins, Baltimore, Md.). x + 220 pp. \$6.50.

Blond presents the following revolutionary theory.

1) Only hepatopathogens are cancerogenic. Impairment of the liver's detoxifying function is followed by a rise in portal pressure, dilatation of capillaries in the alimentary organs, stasis, congestion and reversal of the blood flow. The resulting clinical syndromes are gastritis, duodenitis, pancreatitis, peptic ulcer, cholecystitis, colitis, polyposis, hemorrhoids, and so forth. Via portocaval shunts, undetoxicated metabolites enter systemic circulation, and precancerous pathology develops also in organs drained by the venae cavae. Finally, in some precancerous area the toxic metabolites induce mutation, and cancer starts growing. If it is not severely damaged, the liver is more resistant to the mutagenic action of the toxic metabolites than are other organs; hence, the rarity of hepatomas.

2) As long as the liver detoxifies satisfactorily, cancer cannot develop, because it thrives only on toxic products of digestion. Because of the limited amount of toxic metabolites, as a rule only one primary tumor grows. After removal of a primary tumor, toxic metabolites become available for areas with metastatic cells up to then dormant. It is not cancer that kills but the liver's failure, and the liver frequently does fail before cancer has developed.

3) Combat of cancer requires prevention and cure of liver damage. Surgery, irradiation therapy, and immunization are of no avail. If the liver is cured, spontaneous tumor regression follows. Skin epithelioma cannot immunize against internal cancer, because skin epithelioma is a precancerous condition, not a cancer, and because cancer is not a bacterial or viral disease.

The theory is startling and fascinating for its simplicity and scope. There are no tests available to prove or to disprove the thesis that the liver starts and keeps the ball rolling. Being aware of this, Blond amasses a large body of clinical,

experimental, statistical, and biochemical findings in agreement with, and in support of, his theory. It is circumstantial evidence. Not all of his interpretations are convincing, but some are more probable than the currently accepted explanations. I feel gratified that within 2 years my own book, *Cancer in Man*, has inspired this surgeon in London to discuss it thoroughly, to accept some conclusions, to modify or reject others, and to develop a new unified cancer theory. The merits of the latter will have to be assessed at another occasion.

SIGISMUND PELLER

New York, N.Y.

**Stochastic Models for Learning.** Robert R. Bush and Frederick Mosteller. Wiley, New York; Chapman and Hall, London, 1955. xvi + 365 pp. Illus. \$9.

In this volume the authors present a general mathematical model for learning, where learning is defined as "any systematic change in behavior . . . whether or not the change is adaptive, desirable for certain purposes, or in accordance with any other such criteria" (page 3). Because behavior is viewed as a statistical phenomenon, the mathematical system presented is a probabilistic one.

The organization of the volume follows the three main steps in the construction of a mathematical model—setting up the mathematical system, identifying the elements of the system in terms of certain variables in the learning process, and applying the system to specific problems. Part one deals with an exposition of the system whose basic elements are a set of mutually exclusive and exhaustive alternatives, a vector of probabilities with one element for each alternative, a set of mutually exclusive and exhaustive events, and a set of operators corresponding to these events. An element of the probability vector represents the probability of the occurrence of the corresponding alternative when there is an opportunity for choice among the alternatives. The occurrence of an event implies that the corresponding operator, represented by a stochastic matrix, is applied to the set of probabilities to yield

a new set of probabilities. Various consequences of the mathematical system are examined under various assumptions regarding the parameters of the system. Monte Carlo methods—or "stat-rats"—are described which may be used to obtain approximate values of the moments and other characteristics of the probability distributions arising from the model.

In the discussion of identification, the question of estimating the parameters of the system is covered, as well as the definition of the parameters in terms of the psychological variables. Although maximum likelihood estimates are considered desirable, the difficulty of computing such estimates leads the authors to some interesting approximation procedures. Finally, the model is applied to data taken from several types of learning experiments—verbal learning, avoidance training, imitation, and so on.

Although they demonstrate that their model works fairly well in some experiments, the authors, in an excellent concluding chapter, discuss the shortcomings of this model. The inability of the model to handle response intensity—that is, a response beyond the occurrence or non-occurrence of a response class—and the assumption of linearity of the event operators are recognized and discussed by the authors as two limitations on the "generality" of their model. The discussion of the relationship between model building and curve fitting is an excellent one and, together with the introduction, is an interesting—if too brief—presentation of the purpose, methods, and usefulness of mathematical model building. While the authors are rightfully modest about the general applicability of their model to learning problems, they have added substantially and significantly to the literature of mathematical models in the social sciences.

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**Principes Fondamentaux de Classification Stellaire.** Colloques, Internationaux du Centre National de la Recherche Scientifique. Le Centre, Paris, 1955. 188 pp. Illus. F. 1.200.

A conference on stellar spectroscopy from the point of view of stellar classification was held at the Astrophysical Institute in Paris in the summer of 1953, and this book gives an account of the papers presented, together with the comments made at the time by the participants. There are contributions from American, Danish, Dutch, and Soviet astronomers in addition to those of the French hosts, and all papers with comments have been translated into French.

Apart from various short remarks, there are 15 papers, ranging from a clear account of the current theory of the spectral-type by Pecker in which the many difficulties are emphasized, to an important discussion by Strömberg of his work on a two-dimensional classification of F-type stars using photoelectric photometry with interference filters.

Among the other contributions, Morgan has a short discussion of the problem of the spectral classification of the two stellar populations. Deutsch, in a paper illustrated with Palomar coude spectrograms, reports on observations related to stars that are members of open or globular clusters; he discusses among other things the distribution of rotational velocities in stars of early type. Barbier has an interesting account of the use of the position and magnitude of the Balmer discontinuity in spectral classification, while Chalange proposes to make the Morgan-Keenan system more precise by the introduction of a third parameter, the absolute gradient in a prescribed spectral region.

Certain problems became apparent during the discussion. For example in Chalange's three parametric classification system, it happens that high-velocity stars differ systematically from low-velocity stars. This is a special case of the general problem of finding more fundamental relationships between spectral-type properties of stars and their other characteristics, such as rotation, space motion, and light variability. Such relationships when found might serve to unify somewhat the various families in which stars are now divided. This book can be recommended to students of stellar spectroscopy and statistics as giving an account of the many problems current in this field.

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**The Flood Control Controversy.** Big dams, little dams, and land management. Luna B. Leopold and Thomas Maddock, Jr. Ronald Press, New York, 1954. xiii + 278 pp. \$5.

Free enterprise implies the assumption of risk. But we have long since abandoned the idea of unlimited risk, preferring some degree of control in the interest of general welfare. A nice problem arises, however, in deciding upon the extent to which general versus special interest is to be served when fiscal and legislative measures for minimizing risk are proposed. Certainly there has been an increasing drive on the part of special groups in industry, business, and agriculture to eliminate, at public expense, any risk so far as they are concerned.

Flood control, so-called, is an excellent case in point, now absorbing expenditures in the billions of dollars. Quite apart from immediate administrative and technical considerations, this activity involves principles that impinge upon the character and destiny of our national life. The Conservation Foundation, dedicated to the conservation of renewable natural resources, has performed a notable public service in making possible the writing of *The Flood Control Controversy*, in every way an unusual book. Leopold and Maddock, on leave, respectively, from the U. S. Geological Survey and Bureau of Reclamation, have had access to many unpublished records and to comment from government officials. Their fitness is further evident from the clarity and power of their writing and the competence with which they have analyzed and presented matters of great technical complexity. Flood control, they point out, is itself a misnomer. What is really involved is the reduction of flood hazard and damage. The basis of the problem lies in the competition between cultural and geologic processes. Channel and floodplain are alluvial phenomena, "creatures" of the river. At the same time valley lands are often highly productive for agriculture and convenient for urban development. In principle their use by man involves hazard and should be regarded as a calculated risk, like the establishment of vineyards on the slopes of a volcano. A sardonic footnote on the intensity of urban use comes from the fact that prudent investors may avoid flood risk, making lowlands inexpensive and attractive to others. Again, the erection of flood "control" works may result in false optimism and increased intensity of use. Thus the process of protection naturally leads to the necessity for still further protection.

Under a concept that has been growing since the 1930's remedial measures are no longer a charge against the direct beneficiaries but against the commonwealth. Further, the alienation of space for engineering works disrupts the economy upstream from those benefited—a situation that would not have been tolerated prior to 1900 when economy and politics were still largely rural.

Even today it meets with protest, manifest as the little dam-big dam controversy, essentially the subject of this book. As one who welcomed a reexamination of the almost exclusively engineering philosophy as applied to watersheds and attacked in Elmer Peterson's *Big Dam Foolishness* [*Sci. Monthly* 81, 43 (1955)], I regret that *The Flood Control Controversy* was not available when Peterson wrote his lively polemic.

Responsibility for minimizing flood damage is divided between two agencies

—Army Engineers and the Department of Agriculture. The Army Engineers work upward from the lower channels where flood damage has high visibility and where they have been traditionally engaged in improvement of navigation. In a sense they typify urban pressures. Agriculture is assigned to work downward from the headwaters and obviously spearheads the rural viewpoint. Having realized that improved land use and land management can alleviate, but not control, the flood problem, the Department of Agriculture has ventured into the engineering field with headwater dams. Thus we have, over and above any conflict of philosophy, a tangible one of jurisdiction.

As the authors take care to point out, neither approach is a substitute for the other. To the degree that flood "control" measures can be justified (and this is by no means yet clear, either from the facts or from the present allocation of costs) the downstream and upstream approaches are complementary. There is no question that, under any type of valley management, exceptional patterns of rainfall may get a drainage system out of hand. Nor should there be any question regarding the need for a watershed under sound land use and management before costly and permanent engineering works are set up downstream. I hold painful recollections of the Grand River fiasco, in which my advice to safeguard any dam by an initial program of soil conservation was summarily rejected.

As the authors say, flood "control" is now big business. It is up to those who foot the bill to control the "control," and a practical first step for the citizen is to read this excellent book. A further step, devoutly to be wished, is for more men in responsible places to develop the same broad combination of engineering discipline and biological insight as Leopold and Maddock.

Perhaps it is not too much to hope that they can be induced to apply their gifts to a similar analysis of the irrigation and reclamation problem, which up to the present has seemed highly elusive.

Three very minor points may be mentioned in concluding this review. The technical distinction—and it is important—between land use and land management is somewhat blurred. The alleged effect of levees in raising the stream-bed level is not discussed. And finally in accepting present patterns of land use as more or less economically necessary, no account is taken of the recent remarkable progress of the art of grass farming or of the artificial effects of crop subsidies. But these matters are more than offset by the authors' clear and repeated insistence on the need for more fundamental and more long-continued research. One of the tragic costs



of democracy is the waste of money and talent when projects that should continue through decades are allowed to wither for lack of sustaining appropriations. The hit-and-run techniques that at times serve developmental research in the physical sciences will not do when we are dealing with secular processes. These processes furnish background, perspective, and context for the effective application of all science.

PAUL B. SEARS

*Yale University Conservation Program*

**The Language of Social Research.** A reader in the methodology of social research. Paul F. Lazarsfeld and Morris Rosenberg, Eds. Free Press, Glencoe, Ill., 1955. xiii + 590 pp. Illus. \$6.75.

This reader is one of a growing list of books on social science methodology that have been published in the last several years. It represents the continuation of what seems to be an increasingly concerted effort to make explicit the design of social research and to codify social science procedures and techniques.

The volume is, on the whole, an excellent collection of papers. By being brought together, these papers are not only made more readily accessible, but they also take on a cumulative value as contributions to the development of more objective and rigorous social science research.

The work, however, contains many gaps and deficiencies, partly because it does not set out to cover all of social science method and partly because it reflects the present relatively primitive state of social science. The "Reader" does not attempt to cover such topics as sampling, questionnaire construction, and experimental design for which "there is already a standardized literature. It does not deal with mathematical techniques that require knowledge "beyond that which the average social scientist is likely to have." It excludes also consideration of topics whose "methodological implications have not yet been codified adequately at all." It purports to emphasize the "analysis of material which has been properly collected." The editors appropriately admit that the selections are not necessarily representative of the literature but were gathered in considerable measure from the work of "colleagues and junior associates of the senior editor" in his work at Columbia University. However, it may be noted that this does not detract from the apposite character or usefulness of the selections.

The materials written by the editors, while all too brief, together with the outline of the book, do give the work some measure of cohesion and provide, on the

whole, an adequate rationale for the selection of the readings. In a brief general introduction and short introductory statements to each of the six sections into which the volume is divided, a general conception of science is presented and the following major topics are treated: "Concepts and indices," "Multivariate analysis," "The analysis of change through time," "Formal aspects of research on human groups," "The empirical analysis of action," and "Toward a philosophy of the social sciences." Especially useful is the contribution of the editors to the clarification of the steps involved in the delineation of problems for research and in the analysis and interpretation of research results.

The volume is not a self-sufficient treatise on social science methodology. Its title is, therefore, rather too comprehensive in that it covers only a small part of the "language of social research." As a supplement to more comprehensive works on the philosophy of science and on social science method, it is, nevertheless, a useful contribution to the literature.

PHILIP M. HAUSER

*University of Chicago*

**The Pharmacological Basis of Therapeutics.** Louis S. Goodman and Alfred Gilman. Macmillan, New York, ed. 2, 1955. xiii + 1831 pp. Illus. \$17.50.

There is a certain fascination in comparing the first and second editions of this book—the 14 years elapsed are paralleled by remarkable advances in many directions. The antibiotics, the newer adrenal steroids, adrenergic blocking agents, radioisotopes, and antihistaminics are all substances that were largely unknown at the time of the first edition.

The growth in the amount of subject matter has resulted in an increase in both the bulk and price of the book by about 50 per cent; it cannot be said that pharmacology has become much more comprehensible in terms of mechanisms during the last 10 years or so, but the fact that the authors have been able to encompass the multitude of new developments in their text bespeaks much in the way of organizational effort. This is a medical textbook, and as such its treatment ought to be directed toward practical ends; nevertheless there is much use made of Goodman and Gilman by research workers who are not primarily concerned with medicine, and it is therefore gratifying to find that the treatment of structure-activity relationships of various classes of drugs has been greatly expanded in this new edition. As was true in the first edition, the treatment of autonomic drugs is particularly outstanding, and I am also impressed with the

concise presentation of the vast literature connected with the adrenal steroids. The fact that a substance that was discovered as recently as aldosterone is covered in some detail is an indication of the continuous revision of the text that must have taken place up to the time of publication. There are a few errors: the partition coefficient is incorrectly defined, the structure of podophyllotoxin appears to be out of date, and it is somewhat surprising not to find serotonin listed. These minor errors in no way detract from the general impression that this is both a reference work and a textbook of the most reliable sort.

L. J. MULLINS

*Purdue University*

**Advanced Calculus.** An introduction to classical analysis. Louis Brand. Wiley, New York; Chapman and Hall, London, 1955. xii + 574 pp. Illus. \$8.50.

The nature of this book is indicated by its subtitle, "An introduction to classical analysis." It differs from books on elementary calculus in two major respects: (i) in the emphasis given to definitions, theorems, and rigorous proofs; and (ii) in the inclusion of chapters on "Vectors" (Chapter 5), "Line integrals" (Chapter 8), "Uniform convergence" (Chapter 10), "Functions of a complex variable" (Chapter 11), and "Fourier series" (Chapter 12). Some other more advanced topics are treated briefly in sections of various chapters—for example, implicit function theorems and Lagrange multipliers with "Functions of several variables" (Chapter 4) and Green's and Stokes' theorems, with "Multiple integrals" (Chapter 9). As the author states, the book deals essentially with functions of a real variable. His purpose in including Chapter 11 is to complete the explanation of certain portions of real variable theory—for example, intervals of convergence for series—and to show the use of complex integration in computing certain real integrals.

The development of the real and complex number systems is sketched in Chapter 1. In Chapter 2 ("Sequences and series") some of the basic concepts of analysis are introduced in their simplest setting. Chapter 3 ("Functions of a real variable"), Chapter 6 ("The definite integral"), and Chapter 7 ("Improper integrals") are largely a review of elementary calculus, but with the different emphasis that I have mentioned. Only the Riemann integral is considered.

The book generally is on the usual level of courses in advanced calculus for undergraduates and beginning graduate students. It is better suited for those majoring in mathematics than it is for phy-

sicists or engineers because it lacks applications. There are many exercises, most of them quite straightforward, with answers compiled at the end. This feature doubtless will increase the appeal of the book to readers using it for self-study. The summaries at the ends of the chapters are another good feature. In my opinion, some additional suggestions for outside reading and mathematical report writing would enhance the usefulness of the book as a text.

RALPH HULL

Purdue University and  
Ramo-Wooldridge Corporation

**Karl Patterson Schmidt Anniversary Volume in Honor of His Sixty-fifth Birthday.** Fieldiana: Zoology, vol. 37. Chicago Natural History Museum, Chicago, 1955. viii + 728 pp. Illus. + plates. \$10.

Appreciative accounts of Karl Patterson Schmidt by his administrative associates are followed in this book by 26 scientific articles, by 27 zoologists, on living and fossil animals from all five continents and several islands. Taxonomy, nomenclature, anatomy, geographic distribution, speciation, food habits, paleontology, and other aspects of vertebrates and invertebrates are dealt with.

In the past 30 years the advancing front of knowledge in taxonomy, phylogeny, and geographic distribution of animals—especially living animals—has lagged behind that in genetics, biochemistry, and microbiology. To consolidate and apply much of the information recently acquired in the last-mentioned fields, and to permit further advances in some of them, more precise knowledge of the taxonomy and natural history of most animal groups is now required. Consequently, the information in the Karl Patterson Schmidt volume is timely as well as basic in nature. From it we learn much about the natural relationships among the 80 species of snakes of the genus *Calamaria*, the northward limits of geographic range in Mexico of many neotropical bats, the 42 kinds (23 are new!) of obligate parasitic amblyopine beetles that live on rodents and marsupials; we also learn which of the nominal species of Columbian gallinaceous birds are valid and which are not, what foods are eaten by scores of kinds of fishes, and much about the species of fishes of the genus *Holocentrus* that are arranged according to the heretofore imperfectly known anatomical and functional relationships between the auditory bulla and swim bladder. In addition, we learn that the premaxillary fossa on the lower jaw of the living spectacled bear accommodates a pouch of the mouth cavity and is

not a place of attachment for a separate portion of the chewing musculature as the literature and our professors wrongly taught us about the closely related, extinct *Tremarctotherium*. Prevailing westerly winds acting on migrants account for the American origin of the bird fauna of Tristan de Cunha. Students of paleozoology will find in the volume well-illustrated and competently described missing links that make speculations unnecessary concerning the phylogeny of some lines of sea turtles, symmetrodont mammals, early crabs, and Devonian fishlike Heterostrachi that are useful in correlating discontinuous geologic deposits.

The basic nature of the original information in the Karl Patterson Schmidt volume guarantees long-time recognition of the deserved honor that it does him.

E. RAYMOND HALL

University of Kansas

## New Books

*Experimental Pharmacodynamics.* T. Koppányi and A. G. Karczmar. Burgess, Minneapolis 15, 1955. 256 pp. \$5.

*Metallurgical Progress.* vol. 2. Philosophical Library, New York; Cassier, London, 1955. 71 pp. \$6.

*Plastics and Building.* E. F. Mactaggart and H. H. Chambers. Philosophical Library, New York, 1955. 181 pp. \$12.

*Present-Day Psychology.* An original survey of departments, branches, methods, and phases, including clinical and dynamic psychology. A. A. Roback, Ed. Philosophical Library, New York, 1955. 993 pp. \$12.

*Particle Size Determination.* R. D. Cadle. Interscience, New York, 1955. 303 pp. \$5.50.

*Mutual Aid. A factor of evolution.* Petr Kropotkin; foreword by Ashley Montagu; "The struggle for existence" by Thomas H. Huxley, *Extending Horizons* Books, Boston 8, Mass., 1955. 362 pp. Cloth, \$3; paper, \$2.

*Biochemistry of the Developing Nervous System.* Proceedings of the First International Neurochemical Symposium, held at Magdalen College, Oxford, 13-17 July 1954. Heinrich Waelsch, Ed. Academic Press, New York, 1955. 537 pp. \$11.50.

*Histamine: Its Role in Anaphylaxis and Allergy.* M. Rocha e Silva. Thomas, Springfield, Ill.; Blackwell, Oxford, England, 1955. 248 pp. \$7.50.

*The Guilty Mind.* Psychiatry and the law of homicide. John Biggs, Jr. Harcourt, Brace, New York, 1955. 236 pp. \$4.50.

*Kinships of Animals and Man.* A textbook of animal biology. Ann H. Morgan. McGraw-Hill, New York, 1955. 839 pp. \$6.75.

*Bibliographia Araneorum.* vol. II, pt. 1. Pierre Bonnet. The Author, Université de Toulouse, 1955. 918 pp. \$23.

*Structure of the Ego.* An anatomic and physiologic interpretation of the psyche based on the psychology of Otto Rank. Lovell Langstroth. Stanford Univ. Press, Stanford, Calif.; Oxford Univ. Press, London, 1955. 149 pp. \$4.

*Smithsonian Institution, Annual Report of the Board of Regents.* Publ. 4190. U.S. Govt. Printing Office, Washington, 1955. 455 pp.

*Fishes of Japan.* Illustrations and descriptions of the fishes of Japan. Yaichiyo Okada. Maruzen, Tokyo, 1955. 463 pp. \$10.

## Miscellaneous Publications

(Inquiry concerning these publications should be addressed, not to Science, but to the publisher or agency sponsoring the publication.)

*Indian Agricultural Research Institute, Souvenir, Golden Jubilee, 1905-1955.* The Institute, New Delhi, 1955. 90 pp.

*South Pacific Commission, Report for the Year 1953.* The Commission, Noumea, 1954. 33 pp.

*Life Insurance Medical Research Fund, Annual Report, 1 July 1954 to 30 June 1955.* The Fund, New York 17, 1955. 92 pp.

*Mineralogy of Some Japanese Mangane Ores.* Stanford Univ. Publ., Geological Sciences, vol. 5. Donald Edward Lee. Stanford Univ. Press, Stanford, Calif.; Oxford Univ. Press, London, 1955. 64 pp. \$1.50.

*Proceedings on the Conference on Interfacial Phenomena and Nucleation.* vols. 1-3. Geophysical Research Papers No. 37. H. Reiss, Ed. Geophysics Research Directorate, Air Force Cambridge Research Center, Cambridge, Mass., 1955. vol. 1, 225 pp.; vol. 2, 190 pp.; vol. 3, 123 pp. (Order from U.S. Dept. of Commerce, Office of Technical Services, Washington 25).

*Symposium on Genetic Recombination.* Given at Research Conference for Biology and Medicine of the Atomic Energy Commission, 19-21 April 1954. Oak Ridge National Laboratory, Oak Ridge, Tenn., 1955. 321 pp.

*Tularemia in Sheep and in Sheep Industry Workers in Western United States.* Public Health Monogr. No. 28. William L. Jellison and Glen M. Kohls. U.S. Public Health Service, Washington 25, 1955. 17 pp. Single copy, free.

*Educational Aids for Schools and Colleges 1955-56.* National Assoc. of Manufacturers, New York 17, 1955. 24 pp.

*Yale Conservation Studies.* vol. 4. Yale Conservation Club, Yale Univ., New Haven, Conn., 1955. 31 pp.

*Marine Sciences Programs in the South.* Regional Committee on Marine Sciences. Southern Regional Education Bd., Atlanta, Ga., ed. 2, 1955. 125 pp.

*Measurement of Vibration.* Ervin E. Gross, Jr. General Radio Co., Cambridge 39, Mass., 1955. 60 pp.

*Results of 1954 Fungicide Tests.* American Phytopathological Soc., 1955 (Order from D. A. Roberts, College of Agriculture, Ithaca, N.Y.). 16 pp. \$1.

*Algunos Problemas Relativos al Equilibrio Químico de Una Fase Gaseosa.* Publicaciones del Instituto de Matematica y Estadística, vol. II, No. 8. Juan J. Schäffer. 28 pp. *Figura Mínima que Cubre Puntos de Una Red. II.* vol. II, No. 9. Juan J. Schäffer. 26 pp. Facultad de Ingeniería y Agrimensura, Montevideo, Uruguay, 1955.

## Scientific Meetings

### Biological Societies

This year has been Michigan State University's centennial year. As part of the yearlong celebration, the American Institute of Biological Sciences planned its annual meeting of biological societies on that campus. Three thousand members of 25 professional societies met 5-9 September; 1145 papers were read, a score of symposia were presented, and eight field trips were organized to precede or follow the meeting sessions.

The societies that met at East Lansing were as follows: American Bryological Society, American Fern Society, American Microscopical Society, American Society for Horticultural Science, American Society of Human Genetics, American Society of Limnology and Oceanography, American Society of Naturalists, American Society of Plant Physiologists, American Society of Plant Taxonomists, American Society of Zoologists, Beta Beta Beta, Biometric Society (ENAR), Botanical Society of America, Ecological Society of America, Genetics Society of America, Mycological Society of America, National Association of Biology Teachers, Nature Conservancy, Phycological Society of America, Potato Association of America, Society for Industrial Microbiology, Society of Protozoologists, Society for the Study of Evolution, Society of Systematic Zoology, and the Animal Welfare Institute.

One of the highlights of the meeting was the general address delivered on 6 September by George W. Beadle (California Institute of Technology) on "What is a gene?" Beadle traced the recent discoveries in biology and chemistry that have greatly increased our knowledge of gene structure and discussed the hypotheses that now quite plausibly explain the structure, function, replication, and mutation of genetic material.

A special symposium, organized and sponsored by six societies, "The taxonomy of cultivated plants," was dedicated to Liberty Hyde Bailey. Another symposium, "Sewall Wright's contributions to population genetics," was held in honor of one of America's outstanding geneticists.

Other prominent symposia were "Antibiotics in agriculture" by the Society for

Industrial Microbiology; the presidential symposium of the American Society of Zoologists, "Problems of morphogenesis"; the annual symposium of the American Society of Naturalists, "Modern approaches to problems of differentiation"; "Arctic and alpine tundras" by the Ecological Society of America; and "Respiration in plants" by the American Society of Plant Physiologists. A few of the interesting papers presented by the members of various societies are summarized in the following paragraphs.

The role of hybrids in agricultural advance has grown in importance in recent years. Bees have now joined the ranks of animals that display hybrid vigor. G. H. Cale (Dadant and Sons) and J. W. Gowen (Iowa State College) analyzed the results of controlled hybridity on egg and honey production. They found that productivity increased 135 percent for eggs and 116 percent for honey and that the hybrids were larger than random country-wide stock by 117 to 124 percent.

A new method for separating the proteins of human blood serum has been devised by O. Smithies and N. F. Walker (University of Toronto). Individual variations were found to exist and to fall into three groups, I, II<sub>A</sub>, and II<sub>B</sub>. Family studies have shown that the serum protein groups are inherited but that they are not correlated with the well-known blood groups, A, B, AB, and O. This information may prove very useful in medical cases of disputed parentage.

C. E. Wildon and C. L. Hamner (Michigan State University) reported that Tiba, 2-3-5-triortho-benzoic acid, hastens flowering in certain floricultural crops. Petunias and zinnias treated with the compound flowered 10 to 20 days ahead of untreated plants. So far, pineapple is the only commercial crop on which Tiba has been used. As a result, pineapple growers are now able to regulate the harvesting date, thereby making better use of labor and machine canners.

Irene Uchida (Hospital for Sick Children, Toronto) told of the high incidence of similar dermal patterns in children with congenital heart disease. It has been known for some time that mongoloid imbeciles have definite patterns on the fingers, palms, and soles. It is be-

lieved that mongolism is the result of disturbed fetal development and, since heart defects often accompany mongolism, a similar prenatal disturbance may be common to both.

True genetic females can now be dispensed with in toads, according to E. Witschi and C. U. Chang (State University of Iowa). Using the clawed toad, *Xenopus*, Witschi and Chang found that male embryos placed under the influence of estradiol developed into egg-producing behavioristic females while their male hereditary constitutions remained unchanged. The eggs, when fertilized by a normal male, produce only males. The estradiol was added to the aquarium water and 1 week's treatment sufficed.

Ruth Sager (Rockefeller Institute for Medical Research) reported on a form of cytoplasmic inheritance in *Chlamydomonas*. One *Chlamydomonas* cell in a million was found to be resistant to large doses of streptomycin. When such streptomycin-resistant cells were mated sexually with streptomycin-sensitive cells, all offspring were found to be streptomycin resistant. Further study showed that the hereditary factor was a particle in the cytoplasm; the chemical identification of these particles is now being investigated.

Two McGill University scientists, C. M. Wilson and I. K. Ross, presented cytological proof of meiosis in the myxomycetes. It was found that reduction divisions of chromosomes took place during the formation of the sporangia but before the production of spores.

As a result of cultivating aquatic actinomycetes on an artificial medium, J. K. G. Silvey (North Texas State College) discovered that these organisms produced many of the tastes and odors commonly attributed to algae blooms. Further investigation showed that the actinomycetes grew on algae, higher aquatic plants, and organic debris, and that they were present in a wide variety of aquatic habitats. Silvey claims that they are responsible for the fishy, marshy, potato-bin, woody, musty, earthy, and manurial smells and tastes that are sometimes found in water. The presence of actinomycetes in sources of drinking water is of economic importance and deserves prompt control research.

M. W. Jennison (Syracuse University) outlined useful applications of wood-rotting basidiomycetes. Many species can be grown under controlled conditions in an aerated, liquid culture, utilizing such inexpensive waste materials as spent brewers' grains, sulfite waste liquor, cannery wastes, food-processing wastes, molasses fermentation residues, and corn cobs. The fermentation products are chiefly organic acids. In addition to using such fungi for disposing of plant wastes and for producing useful fermentation products, the re-



sulting mycelium itself may be valuable as an animal-feed supplement. Mycelium was found to contain 35 percent of protein and some 18 amino acids, including the ten amino acids that are essential in animal nutrition.

After the discovery in 1950 that crude extracts of dehydrated *Boletus edulis* retarded the growth of implanted mouse tumors, E. G. Lucas and J. A. Stevens (Michigan State University), in collaboration with the Sloan-Kettering Institute, tested a wide range of other basidiomycetes. The genera that were found to contain tumor-retarding properties in fresh-plant preparations are *Calvatia*, *Clitopilus*, *Collybia*, *Cortinellus*, *Hydnum*, *Leiota*, and *Polyporus*. Laboratory cultures of *Boletus*, *Collybia*, and *Clitopilus* have also shown active principles.

Chemical defoliation of plants has been practiced for several years. R. H. Biggs and A. C. Leopold (Purdue University) have been able to bring about complete abscission of leaf petioles with auxin concentrations 100 to 10,000 times more dilute than solutions of other chemicals. A correlation was found, however, between the age of the leaves and the success of the auxin defoliating reaction.

Leaf analysis has developed rapidly in recent years as a means of evaluating the nutritive needs of plants and the effectiveness of various types of fertilizers. A. L. Kenworthy reported on a leaf-analysis service, recently established in Michigan, that is one of the first in the country.

Robert C. Bay (Salt Lake City) was awarded the Albert Schweitzer medal for his contributions to the proper care of laboratory animals. The medal and a cash prize of \$500 were awarded for the first time during the East Lansing meetings by the Animal Welfare Institute of New York City.

The Eminent Ecologist citation of the Ecological Society of America was made to A. H. Wright (Cornell University) and the George Mercer award for an outstanding paper in ecology was received by Shelby D. Gerking (Indiana University).

The 1955 awards made by the American Society for Horticultural Science were the Alex Laurie award in floriculture and ornamental horticulture, Henry M. Cathey (Cornell University); the Leonard H. Vaughan award in floriculture, Lennart B. Johnson (University of California); the Charles G. Woodbury award in raw products research, Othmar Silberstein (Westfield, N.Y.); the Leonard H. Vaughan award in vegetable crops, C. M. Geraldson (Bradenton, Fla.); and the J. H. Gourley award in pomology, E. L. Proebsting, Jr. (Prosser, Wash.) and A. L. Kenworthy (Michigan State University).

IILEEN E. STEWART  
Washington, D.C.

## Meeting Notes

■ A conference sponsored by the New York Academy of Sciences on Calcium and Phosphorus Metabolism in Man and Animals with Special Reference to Pregnancy and Lactation will take place in New York, 10-11 Jan. Topics covered will include calcium balance and turnover studies, parathyroid hormone, problems of parturient paresis in dairy cows, calcium complexing agents, and special aspects of calcium metabolism.

Franklin C. McLean of the University of Chicago is general chairman. Participants include: C. L. Comar, Oak Ridge Institute of Nuclear Studies; Max Kleiber, University of California; Genevieve Stearns, University of Iowa; Felix Bronner, Rockefeller Institute; Roy V. Talmage, Rice Institute; Paul L. Munson, Svein U. Toverud, and Roy O. Greep, Harvard School of Dental Medicine; Gerald M. Ward, Colorado Agricultural and Mechanical College; H. H. Cole and J. M. Boda, University of California; J. W. Hibbs and William Pounden, Ohio Agricultural Experiment Station; T. H. Blosser, State College of Washington; Martin Rubin, Georgetown University; Philip H. Henneman, Evan Calkins, David Kahn, Wilma Canada, John D. Crawford, Allan M. Butler, Harvard Medical School; I. Snapper, Beth-El Hospital; W. D. Malherbe, Onderstepoort, South Africa; Joseph Pincus, Isaac Gittleman, and Albert E. Sobel, Jewish Hospital of Brooklyn; Ann M. Budy and John H. Rust, University of Chicago; Gilbert Forbes, University of Rochester; Philip S. Calcagno, University of Buffalo; and H. H. Dukes, Cornell University. For further information write to Dr. R. R. Marshak, Springfield, Vt.

■ The fifth World Conference on Planned Parenthood, sponsored by the International Planned Parenthood Federation and organized by the Family Planning Federation of Japan, took place in Tokyo, 24-29 Oct. More than 100 delegates registered from Australia, Bermuda, Canada, Ceylon, Germany, Great Britain, Hawaii, Hong Kong, India, Israel, Japan, Korea, Pakistan, Sweden, Thailand, Union of South Africa, and the United States.

The conference agenda was devoted to the theme "Overpopulation and planned parenthood." Papers by physicians, sociologists, and population experts covered such fields as world population trends, natural resources, family planning methods, contraceptive research, and marriage guidance.

Major reports were given by Margaret Sanger, IPPF president, and a large U.S. delegation that included Mrs. Robert M. Ferguson, William Vogt, Abraham Stone, Lena Levine, and Thomas Griesemer. Among other American scientists

who presented papers were Edward Ackerman, M. C. Chang, Clarence Gamble, Paul Henshaw, Nadina R. Kavinoky, Warren Nelson, Gregory Pincus, John Rock, J. B. Thiersch and Warren Thompson, and P. K. Whelpton.

■ To recognize 30 years of activity in the Institute of Child Welfare at the University of Minnesota, under the leadership of John E. Anderson, the university is sponsoring a conference on the Concept of Development, 8-10 Dec. Invited guests who will present papers are Viktor Hamburger, Washington University; Hyman Lippman, Amherst H. Wilder Child Guidance Clinic; Howard Meredith, University of Iowa; Ernest Nagel, Columbia University; Willard C. Olson, University of Michigan; T. C. Schneirla, American Museum of Natural History; J. P. Scott, Roscoe B. Jackson Memorial Laboratory; Robert R. Sears, Stanford University; and Heinz Werner, Clark University. For information write to Dr. Dale B. Harris, Director, Institute of Child Welfare, University of Minnesota, Minneapolis 14, Minn.

## Forthcoming Events

### December

26-29. Biometric Soc., Eastern N. American Region, New York, N.Y. (A. M. Dutton, Box 287, Station 3, Rochester 20, N.Y.)

26-31. American Assoc. for the Advancement of Science, Atlanta, Ga. (R. L. Taylor, AAAS, 1025 Connecticut Ave., NW, Washington 6.)

The following 32 meetings will be held in conjunction with the AAAS annual meeting.

26-27. American Assoc. of Clinical Chemists, Atlanta, Ga. (A. E. Sobel, Dept. of Biochemistry, Jewish Hospital of Brooklyn, 555 Prospect Pl., Brooklyn 16, N.Y.)

26-30. American Nature Study Soc., Atlanta, Ga. (M. Trussell, School of Education, Florida State Univ., Tallahassee.)

26-30. National Assoc. of Biology Teachers, Atlanta, Ga. (J. P. Harrold, 110 E. Hines St., Midland, Mich.)

27. National Assoc. of Science Writers, Atlanta, Ga. (O. Fanning, Midwest Research Inst., Kansas City, Mo.)

27. National Speleological Soc., Atlanta, Ga. (Bro. G. Nicholas, F.S.C., 114 Hanover St., Cumberland, Md.)

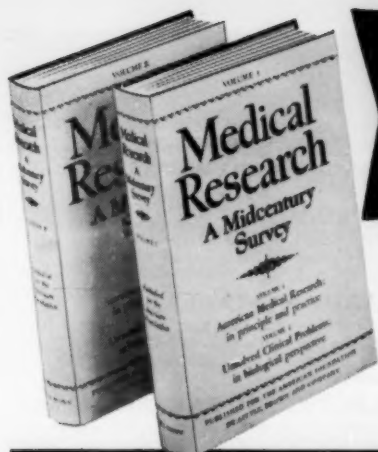
27. Soc. for Research in Child Development, Atlanta, Ga. (W. C. Rhodes, Georgia Dept. of Public Health, Atlanta.)

27-28. American Psychiatric Assoc., Atlanta, Ga. (H. E. Himwich, Research Div., Galesburg State Research Hospital, Galesburg, Ill.)

27-28. Soc. for the Advancement of General Systems Theory, Atlanta, Ga. (L. von Bertalanffy, Psychosomatic Research Inst., Mt. Sinai Hospital, Los Angeles, Calif.)

27-29. American Geophysical Union, Atlanta, Ga. (W. Smith, 1530 P St., NW, Washington 5.)





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Introduction by ESTHER EVERETT LAPE,  
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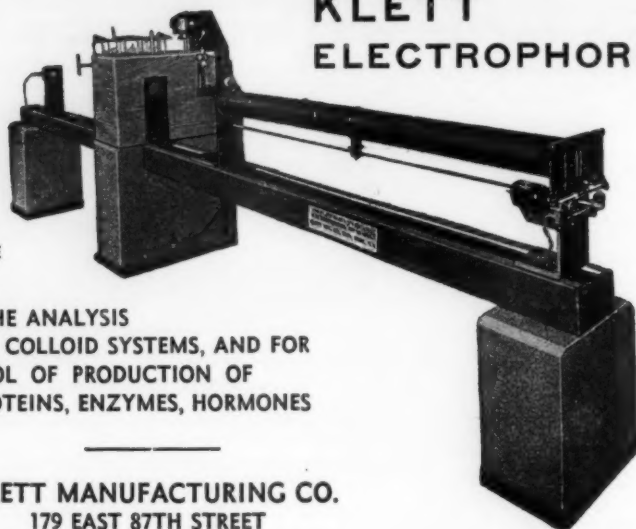
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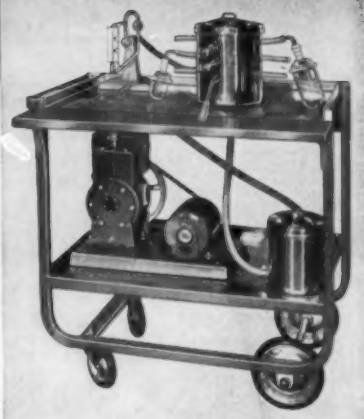
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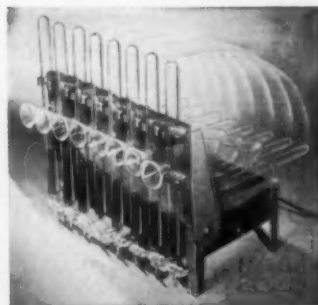
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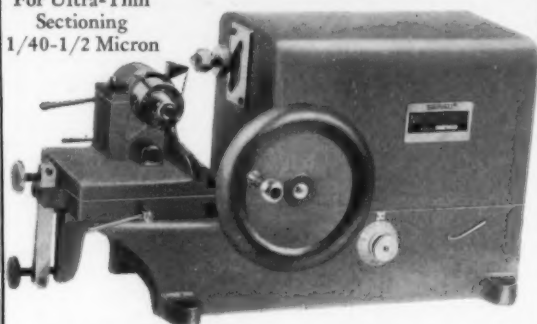
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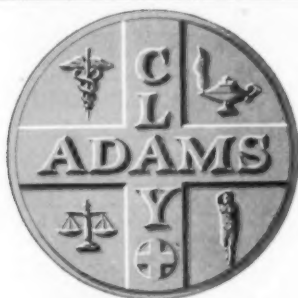
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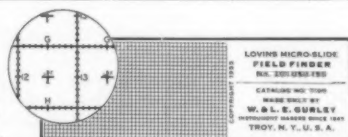
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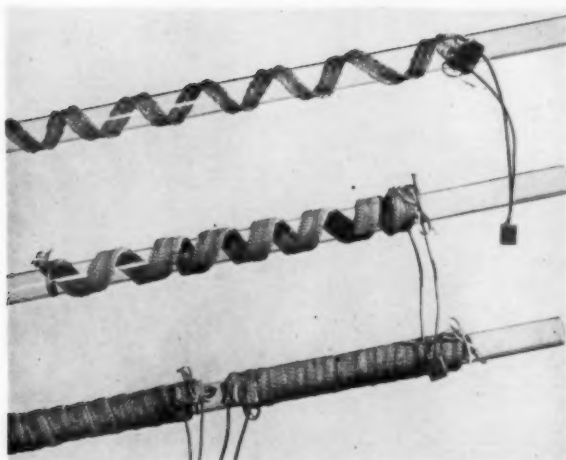
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